REPORT OF PROCEEDINGS

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OF THE

ASSOCIATION OF DOMINION LAND SURVEYORS

AT ITS

FIFTH ANNUAL MEETING,

HELD AT

OTTAWA, MARCH 15TH AND 16TH, 1888.

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To Dominion Land Surveyors.

SHOULD you not be a member of the Association, it is respectfully urged that you at once become such, and by your earnest co-operation assist in making it a means of elevating the standard of the profession, and, by an interchange of ideas, of increasing the scientific knowledge of its members to as great an extent as possible.

Those who are not Dominion Land Surveyors by profession, but whose pursuits, scientific acquirements or practical experience fit them to co-operate with Dominion Land Surveyors in the advancement of professional knowledge, are qualified to join as Associate Members.

Should you be acquainted with any Dominion Land Surveyor who is not a member, or any gentleman qualified to join as an associate member, use your earnest endeavours to make him become such. "IN UNITY IS STRENGTH." Then let us unite together, and as a body be one man with one end in view,

"The Welfare of the Association."

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ASSOCIATION OF DOMINION LAND SURVEYORS.

ORGANIZED APRIL 24th, 1882.

OFFICERS FOR 1888.

Honorary President.

CAPT. E. DEVILLE, SURVEYOR GENERAL............ OTTAWA, Ont.

President.

E. J. RAINBOTH, D.L.S............................ AYLMER, Que.

Vice-President.

JOHN McAREE, D.T.S.............................. TORONTO, Ont.

Secretary and Treasurer.

ARTHUR O. WHEELER, D.L.S..................... OTTAWA, Ont.

Executive Committee.

THOMAS FAWCETT, D.T.S........................ GRAVENHURST, Ont.
J. S. DENNIS, D.T.S................................ AYLMER, Que.
THOMAS BREENE, D.L.S.......................... QUEBEC, Que.

Auditors.

T. D. GREEN, D.L.S................................ OTTAWA, Ont.
G. E. McMARTIN, D.L.S.......................... ST. ANDREWS, Que.

STANDING COMMITTEES

FOR 1888.

Instruments.

G. B. ABREY *(Chairman)*, J. I. DUFRESNE, J. J. McARTHUR.

Geodetic Survey.

W. F. KING *(Chairman)*, OTTO J. KLOTZ, C. MAGRATH.

Publication.

T. D. GREEN *(Chairman)*, C. A. BIGGER, A. DRISCOLL.

Land Surveying.

JOHN McLATCHIE *(Chairman)*, G. E. McMARTIN, WALTER BEATTY

Natural History and Geology.

PROF. J. MACOUN *(Chairman)*, DR. R. BELL, THOS. DRUMMOND.

Permanent marking of Surveys.

S. L. BRABAZON *(Chairman)*, P. T. C. DUMAIS, A. C. WEBB.

Photography as Applied to Topographical Explorations

W. S. DREWRY (*Chairman*), J. J. McARTHUR, J. F. GARDEN.

Topographical Surveying.

OTTO J. KLOTZ (*Chairman*), WM. OGILVIE, EDGAR BRAY.

CONSTITUTION AND BY-LAWS

OF THE

Association of Dominion Land Surveyors.

CONSTITUTION.

ARTICLE I.

Name of the Association.

"The Association of Dominion Land Surveyors."

ARTICLE II.

Objects of the Association.

The promotion of the general interests, and elevation of the standard of the profession.

ARTICLE III.

Members.

1. The Association shall consist of Active Members, Honorary Members and Associate Members.

2. Active Members must be Dominion Land Surveyors, and only such shall hold office.

3. Any Dominion Land Surveyor may become an active member upon payment of the fees prescribed by Article X.

4. Honorary Members must be nominated by two Active Members and the nomination approved by a unanimous vote of the Executive Committee. The nomination with approval must be in the hands of the Secretary-Treasurer at least one month before the Annual Meeting. Persons nominated for Honorary Membership shall submit a Paper to be read at the Annual Meeting. They shall

be elected by ballot in the manner hereinafter provided for the election of officers of the Association. The number of Honorary Members shall not at any one time exceed twenty, and they shall be exempt from payment of dues.

5. *(a)* Associate Members shall be those who are not Dominion Land Surveyors by profession, but whose pursuits, scientific acquirements, or practical experience qualify them to co-operate with Dominion Land Surveyors in the advancement of professional knowledge.

(b) Provincial Land Surveyors of any Province, and Articled Pupils of Dominion and Provincial Land Surveyors, shall be eligible as Associate Members.

(c) Associate Members shall be nominated by one active member in writing to the Secretary-Treasurer, and on approval of such nomination by the Executive Committee shall at once be admitted upon payment of fees prescribed by Article X.

6. Associate Members shall not vote.

ARTICLE IV.

Officers.

1. The Surveyor General of Dominion Lands shall be Honorary President of the Association.

2. The Officers of the Association shall consist of an Honorary President. a President, Vice-President, Secretary-Treasurer, and an Executive Committee, all of whom, except the Honorary President, shall be declared elected at the Annual General Meeting by letter ballot.

3. No member of the Association shall fill the office of President for more than two consecutive years.

4. Nominations for Officers of the Association shall be made to the Secretary-Treasurer in writing by two active members, at least two months before the Annual General Meeting. The Secretary-Treasurer shall prepare and forward ballot papers to the members of the Association, who shall return them marked in sealed envelopes to the Secretary-Treasurer before the date of the Annual General Meeting.

5. The letter ballots shall be opened at the Annual General Meeting, and the majority of the ballots cast in each case shall decide the election.

6. In case of an even or tie vote the election shall be decided by the members present at the Annual Meeting voting by ballot.

7. Should the Secretary-Treasurer not receive three nominations for each of the offices of President, Vice-President and Secretary-Treasurer, or six nominations for members of the Executive Committee, the Executive Committee shall add to the ballot papers a sufficient number of names to make up the number of three candidates for each of the offices and twelve for the Executive Committee.

ARTICLE V.

Meetings.

1. The Annual General Meeting shall commence on the third Tuesday in February, at Ottawa.

2. Special Meetings of the Association may be called by the President, or by the President when requested in writing by three or more members.

3. Eleven members shall form a quorum at any meeting for the transaction of business.

ARTICLE VI.

Amendments.

1. Any member of the Association, who may desire a change in the Constitution of the Association, shall give notice of such contemplated change to the Secretary-Treasurer, at least two months before the next Annual General Meeting, and the Secretary-Treasurer shall, in his notice of such meeting to the members, notify them of the name of the party proposing such change and the nature thereof.

2. No By-law or rule shall be altered, or new one adopted except at a General Meeting, and such amendment shall be voted upon at the said General Meeting, two-thirds majority of the votes cast being necessary for its adoption.

ARTICLE VII.

Executive Committee.

1. The Executive Committee shall consist of the President, Vice-President, Secretary-Treasurer and three members ; and shall have the direction and management of the affairs of the Association. Three members to form a quorum.

2. The Meetings of the Executive Committee to be held at the call of the President, or Secretary-Treasurer.

ARTICLE VIII.

Auditors.

Two Auditors, to be elected by ballot, shall audit the accounts of the Association annually, and present their report of the same at the Annual General Meeting.

ARTICLE IX.

Subscriptions.

1. The fee for membership for Active Members shall be five dollars, and an annual subscription of two dollars for each subsequent year ; both payable in advance.

2. The fees of Active Members shall be forwarded to the Secretary-Treasurer with the ballot papers for election of Officers, and any ballot unaccompanied by the fees mentioned in subclause shall not be counted in the Election.

3. Associate Members shall pay a fee of two dollars annually.

BY-LAWS.

ORDER OF BUSINESS.

1.

1. Reading of Minutes of Previous Meeting.
2. Reading of Correspondence and Accounts.
3. Propositions for Honorary Membership.
4. Balloting for Honorary Membership.
5. Reports.
6. Unfinished Business.
7. New Business.
8. Election of Officers.
9. Adjournment.

2. All motions must be in writing, and shall contain the name of the mover and seconder, and must be read by the Chair before being discussed.

3. Reports of Committees must be in writing, signed by the Chairman thereof.

4. No member shall speak on any subject more than once, except the introducer of the subject, who shall be entitled to reply ; every member, however, shall have the right to explain himself, subject to the discretion of the Chair.

5. When a motion has been finally put to the meeting by the Chairman, all discussion thereon shall be closed.

6. The Chairman shall appoint two scrutineers when a ballot is taken.

7. Every member while speaking shall address the Chair.

DUTIES OF OFFICERS.

1. The President shall preside at all meetings at which he is present; in his absence the Vice-President; and in the absence of both the meeting shall appoint a Chairman.

2. The presiding officer shall only have a casting vote, not a deliberate one.

3. The Secretary-Treasurer shall keep an accurate record of all meetings, conduct all correspondence, announce all meetings, receive all fees and subscriptions and other moneys, pay no bills unless sanctioned by the Executive Committee and signed by their Chairman, make an annual report of all receipts and disbursements, and shall perform such other duties as may from time to time be assigned him by the Executive Committee.

FIFTH ANNUAL MEETING.

OF THE

Association of Dominion Land Surveyors,

Held at Ottawa, March 15th and 16th, 1888.

The meeting had been set for March 13th and 14th, but owing to a snow blockade, which happened at the time, a postponement until the 15th inst. was unavoidable. The blockade was the cause of the absence of the President and many members who had signified their intention to attend.

Programme.

THURSDAY, MARCH 15, 9.30 A.M.

Meeting of Executive Committee.
Reading of Minutes of previous meeting.
Reading of correspondence and accounts.
Propositions for membership.
Balloting for membership.

THURSDAY, 2.30 P.M.

Report of Secretary-Treasurer.
Report of Auditors.
Business of the Association.
President's Address.

PAPER—"The Yukon River and its Sources" WILLIAM OGILVIE, D.L.S., Ottawa, Ont.

THURSDAY, 7.30 P.M.

PAPER—"The placing of Permanent Marks in the field as a means to preserve information afforded by Public Surveys." S. L. BRABAZON, D.L.S., Portage-du-Fort, Que.

PAPER.—"British Government Surveys." Staff-Commander J. G. BOULTON, R. N., London, Eng.

PAPER—"Natural History in connection with the Topographical Survey." PROF. MACOUN, F.L.S., Asst. Director Geological Survey, Ottawa, Ont.

FRIDAY, 10.30 A.M.

Report of Committee on Memorial, setting forth a scheme for the inception of a Geodetic Survey in Canada. OTTO J. KLOTZ, D.T.S., *Chairman.*

Unfinished business.

Election of Officers.

FRIDAY, 2 P.M.

Meeting of Committee to amend Constitution. Biographical Sketches of the late Andrew Russell, Esq., of Ottawa, and H. H. Stephens, Esq., of Owen Sound, deceased, by J. S. DENNIS, D.T.S., Aylmer, Que.

PAPER—"Map Making." J. H. BROWNLEE, D.L.S., Brandon, Man.

PAPER—"Mining in British Columbia." THOMAS DRUMMOND, D.T.S., Kamloops, B.C.

PAPER—"Relations between Master and Man on a survey party." JOHN MCAREE, D.T.S., Toronto, Ont.

FRIDAY, 7.30 P.M.

Report of Committee to amend Constitution.

Appointment of Standing Committees.

PAPER—"Some methods of determining Geographical Positions." W. F. KING, D.T.S., Ottawa, Ont.

PAPER—"Electrical Apparatus in Longitude Work." OTTO J. KLOTZ, D.T.S., Preston, Ont.

PAPER—"Ranching and Irrigating in British Columbia." THOMAS FAWCETT, D.T.S., Gravenhurst, Ont.

Adjournment.

SATURDAY, 2.30 P.M.

Meeting of Committee appointed with regard to a Geodetic and Trigonometrical Survey of the Dominion.

Meeting of Executive Committee of the Association with reference to Memorandum on Geographical Nomenclature and Orthography.

Full discussion after each paper.

EXHIBITS.

PHOTOGRAPHIC VIEWS.

The following valuable and interesting collections of photographs were exhibited throughout the various sessions of the meeting.

1. Views taken along the line of the Canadian Pacific Railway, in British Columbia, and at Vancouver, New Westminster, and Victoria, by CAPTAIN E. DEVILLE, Surveyor General, and kindly loaned by him for the occasion.

In this collection special mention may be made of an enlarged photograph of Mt. Field, views of Mount Stephen, Cathedral Mountain, The Golden Stairs, and Albert Cañon on the Illecille-waet River.

2. A large collection taken by Dr. DAWSON, Assistant Director of the Geological Survey, and Mr. WILLIAM OGILVIE, D.L.S., along the Stickeen, Dease, Pelly, Lewis and Yukon Rivers. The most striking were views of Taiya Inlet, Miles Cañon, Rink Rapids, the Hootalinqua River and Lake Francis.

3. Dr. BELL, Assistant Director of the Geological Survey, exhibited a very fine collection, illustrating the Hudson Straits and the headwaters of the Ottawa River, and chiefly remarkable for picturesque beauty and artistic grouping.

4. Last but not least, Mr. J. B. TYRRELL, of the Geological Survey, showed by his views of the Duck and Riding Mountain District how very attractive a naturally flat and unattractive country will become if the points of view and other conditions are carefully selected. Mr. TYRRELL'S rendering of the "Noble Red Man," and his home, is simply perfect.

INSTRUMENTS.

1. Among the instruments exhibited the "Station Pointer," used by Staff Commander J. G. BOULTON, R.N., in his hydrographic survey of the Georgian Bay of Lake Huron, created much interest.

For a description of this instrument and method of use, see Commander Boulton's Paper on "British Government Surveys."

2. "The Telegraphic Switch Board," "Chronograph Battery," and "Chronometers," used by W. F. KING, Chief Inspector of Surveys, and OTTO J. KLOTZ, D.T.S., in their longitude determinations during the year 1887, were well worthy of observation, and the more so that Mr. Klotz and Mr. King gave a practical illustration of the methods used, the batteries and instruments working just the same as when in actual determination. For explanation, see Mr. Klotz's Paper on "Electrical Apparatus in Longitude Work."

FIFTH ANNUAL MEETING

OF THE

Association of Dominion Land Surveyors,

Held at Ottawa, March 15th and 16th, 1888.

MINUTES OF THE MEETING.

THURSDAY, March 15th.

Morning Session.

The Association assembled, on Thursday, March 15th inst., at St. Andrew's Hall, Ottawa. The meeting opened at 10.30 a.m. E. J. RAINBOTH, Vice-President, in the Chair.

The Minutes of the preceding annual meeting having been read, were duly approved and confirmed.

The reading of the correspondence brought forth the following resolutions:

On letter from H. H. Robertson, St. Thomas de Montmagny, suggesting that every member of the Association should receive every year the reports and maps issued annually by the following Departments of the Government: Department of the Interior, and Geological Survey, Department of Railways and Canals, and Department of Public Works.

Resolution No. 1.

Moved by J. S. DENNIS, seconded by JOHN MCAREE, and *Resolved :*

That the Secretary-Treasurer be instructed to take the necessary steps to obtain, if possible, the reports and maps mentioned in Mr. Robertson's letter, and if successful to distribute the same annually to the members of the Association.

On notice from John Wiley and Sons, publishers, New York, to the effect that they had sent 50 catalogues for the use of the Association.

Resolution No. 2.

Moved by JOHN McAREE, seconded by G. B. ABREY, and *Resolved:*

That the Secretary-Treasurer be instructed to pay the Customs duty on the catalogues from John Wiley and Sons, now in hand, and to procure the same for the benefit of this Association.

On letters from members of the Association, enquiring if any arrangements had been made with the several railway companies with regard to reduced rates to and from the place of meeting.

Resolution No. 3.

Moved by T. D. GREEN, seconded by A. O. WHEELER, and *Resolved:*

That Messrs. John McAree, G. B. Abrey, the mover, and the seconder, be appointed a committee to enquire and confer with the different Railway Companies with regard to allowing Dominion Land Surveyors reduced rates to and from the Association meetings.

Letters from Benjamin Thompson, late Secretary-Treasurer of the Ohio Society of Surveyors and Civil Engineers, enquiring if any work had been published on the construction of the Canadian Pacific Railway, also as to power of telescope most commonly used among the profession in Canada, was duly discussed, and the Secretary-Treasurer instructed to write Mr. Thompson to the effect that no known work had been published on the construction of the Canadian Pacific Railway from a professional standpoint, also that the power of telescope used had a very wide range, 19.32 for terrestrial work up to 61 for astronomical work, largest size 1½ inch object glass, focal length 11 inhces.

Letter from A. M. Burgess, Deputy Minister of the Interior, replying to Memorial regarding Railroad Right of Way Surveys, dated February, 1886, was read, and in the absence of the President, Thomas Fawcett, was put by as unfinished business. (For letter see President's Address, page 22.)

The accounts having been read were disposed of by

Resolution No. 4.

Moved by JOHN McAREE, seconded by T. D. GREEN, and *Resolved:*

That the accounts as audited be accepted.

The remainder of the morning Session was taken up with propositions and balloting for new members.

On recommendation of J. S. DENNIS and A. O. WHEELER, two names for Honorary and nine for active membership were laid before the meeting and duly added to the roll.

Afternoon Session.

The meeting was called to order at 2.30 p.m. E. J. Rainboth, Vice-President, in the Chair.

On the recommendation of G. E. McMartin and A. O. Wheeler, Charles T. Symmes, D.L.S., was elected a member of the Association. The Secretary-Treasurer presented his report, which was adopted. (See page 37.)

In connection with the discussion upon the Secretary-Treasurer's report, the following resolutions were passed:

Resolution No. 5.

Moved by John McAree, seconded by R. C. Laurie, and *Resolved:*

That the sum of fifty cents be charged for single copies of the Annual Report of Proceedings.

Resolution No. 6.

Moved by G. B. Abrey, seconded by J. S. Dennis, and *Resolved:*

That a single copy of the Annual Report of Proceedings be sent to the Library of the Canadian Institute, to include all previous reports.

Resolution No. 7.

Moved by J. S. Dennis, seconded by John McAree, and *Resolved:*

That the Secretary-Treasurer be instructed to effect an exchange of Reports with the following Societies:—Michigan, Ohio, Illinois, Connecticut, Colorado, and the P. L. S. Associations of the different Provinces of the Dominion. Fifty copies to be sent to each.

Resolution No. 8.

Moved by J. S. Dennis, seconded by G. E. McMartin, and *Resolved:*

That the Secretary-Treasurer, the Vice-President, W. F. King, John McAree, G. B. Abrey, the mover and the seconder, be appointed a committee to prepare a statement of the amendments required to the Constitution and By-laws, and that this report be made to this meeting, so that action may be taken forthwith to suspend the rule regarding the two months notice of amendments.

The auditors made a verbal report, stating that the accounts had been examined and found correct.

At this stage of the proceedings the President's Address should have been read, and is here inserted, although owing to the unavoidable absence of the President, the address was not received until after the meeting had adjourned. This will also account for the fact that several important points brought forward in the address were not discussed, and consequently no action taken upon them.

PRESIDENT'S ADDRESS.

GENTLEMEN,

MEMBERS OF THE DOMINION LAND SURVEYORS ASSOCIATION.

With thankfulness to a kind Providence, who has thus far prolonged our existence and permitted us to assemble at our Annual Meeting, I again greet you.

Again are we reminded of our mortality, since we last met, by the death of two gentlemen who were closely connected with our profession.

One especially, who was deservedly called the "Father of Surveying" in Ontario and in the Dominion.

Among all the officers with whom I came in contact in the Department of the Interior, there was not one who inspired so strong a feeling of attachment as did the late Andrew Russell. While he was connected with the Board of Examiners of Dominion Land Surveyors, the most timid candidate who came before him would at once feel encouraged and be inspired by his kind manner.

As Mr. J. S. Dennis will give biographical sketches of the late Andrew Russell of Ottawa, and H. H. Stephens of Owen Sound, deceased, I will drop the veil, not knowing who next will pass from the scene of action.

We gather once more as members of an important family returning from wandering to and fro in our vast Dominion, where the season has been spent in gathering information in regard to its natural sources of wealth, its fitness for sustaining a population, and its suitability for manufacturing interests ; the determination of the correct geographical positions of more important localities along the line of the transcontinental railway and other points, so that the configuration of our Country will gradually approach more nearly to that degree of perfection which may finally be considered practically absolutely correct ; the mapping out and picturing the vast mountain regions which extend as great monuments along the westerly border of our Country, searching out and correcting errors which had crept into the work of former years, penetrating and exploring the regions to the far Northwest and on to the Arctic Ocean, where cold and darkness prevails during the entire winter—I have no doubt but that our comrade, Mr. Ogilvie, who is spending the winter in that dark, cold region, would be very glad if he could be with us at this gathering, and that in thought he would certainly be here if we could communicate with him at this time.

Thus, as heralds and forerunners of those who shall in future years find homes in our Country, the Surveyors have acquired a storehouse of information which others will mould into palatable shape, so that it may be available for general information to those interested.

When we consider the importance of the natural capabilities of this Continent, its mineral wealth, its fitness for agriculture, its grazing resources, its timber supply, and that in connection with every one of these the services of the Surveyors cannot be dispensed with, the knowledge which he possesses being required in every case, we can affirm without contradiction that no class of professional men are more necessary or more important in the development of a country than the class to which we belong.

Countries which have become partly developed without the services of competent professional surveyors have been involved in legal difficulties, from which all the learned professionals and the highest law courts in the land could not extricate them ; and hundreds of worthy, honest and unsuspecting citizens have been involved in ruin.

If preparatory to the settlement of a country, the information acquired by surveyors is important, so also as the country progresses he is an indispensable factor in the laying out of farm lands, villages, towns and cities, in superintending all municipal and other improvements, roads and railways, bridges, harbors and lighthouses.

In fact, there is no branch of industry in which our country can embark, that would not in some way or another affect our profession.

And this is what we want if the country, at large, is going to reap any further benefit than that of simply having their lands laid out and their boundaries defined for them.

We must extend our fields of action, make ourselves more widely acquainted with all the interests of the country, and govern ourselves accordingly.

If any thing of importance is going to be evolved in this direction, it can only be accomplished by organized and united effort.

We cannot possibly, as individuals, each acquire all the branches of knowledge which are necessary to fit us for best serving our nation ; but we can make a specialty of some branch, and become an expert in that particular one, and just here, I think, is a field upon which we may at once enter if we are going to reap any particular advantage from our organization, and I make the suggestion, that at this meeting some scheme may be adopted, by which every member shall have his attention called to some particular branch of the profession, which he will study up and make himself more familiar with, so that he will not have to consider at the last moment what subject he will bring before the next meeting and finally conclude that he cannot do anything.

A committee might be appointed to formulate some plan by which every member of the association would be called upon to contribute to the general information, and our reports in this way would be valuable works of reference, and something which would be creditable to us as well as of great value.

If such a plan could be carried into active operation, it would be an inestimable advantage to every member of the profession.

Each one would reap the benefit of his own researches, and have in the report a concise and well digested account of several branches as given by others, to which he would have access whenever required.

We have now on our roll of honorable membership several noted scientists, whom we intend to use as far as possible by asking them to contribute papers to be published in our annual reports, and to be read at our annual meetings.

We are proud to have these learned gentlemen connected with us, and trust to make our association such that they will not be ashamed of their connection with the land.

In referring to the business of the Association, I must say that our Secretary-Treasurer since his appointment has been very active in his endeavors to further our interests, and has succeeded remarkably well, considering difficulties which no one anticipated at our last meeting, would have to be contended with.

What Mr. Wheeler has accomplished this year proves that we have the right man in the right place.

In referring to the memorial re-right-of-way surveys on railroads, I received from the Deputy Minister of the Interior the following communication, which you will observe is adverse to the contention set forth in the memorial:

OTTAWA, 16th September, 1887.

SIR,

Adverting to your letter of the 25th February, 1886, and the memorial of a Committee of the Dominion Land Surveyors Association therewith enclosed, I beg to say that the whole question therein raised has been under the consideration of the law officers of the Crown, who advise this Department that under the Railway Act the Minister of Railways and Canals may accept such maps and plans or books of reference as he may be satisfied with and as comply with the express provisions of the act, whether or not the Surveys have been made and the maps and plans certified by Dominion Lands surveyors, and that such maps or plans and books of reference, if so accepted, and if certified and signed in the manner provided by the Railway Act, would be legal for all the purposes of that Act, and I am further advised with respect to Government railways, that it is clear that the Government is under no obligation to employ Dominion Land Surveyors to survey the right of way or to prepare the necessary maps or plans.

So far as this Department is concerned, there is nothing in the fact that a licensed surveyor has not made the surveys of a right-of-way, and certified the maps or plans. to prevent the lands included in a crown grant being properly described with reference to such right of way.

I have the honor to be, Sir,

Your obedient servant,

A. M. BURGESS,

Deputy of the Minister of the Interior.

THOS. FAWCETT, Esq., D.T.S.,
Gravenhurst, Ont.

I think it would be advisable to consider the communication in committee to ascertain if possible the ground upon which the advisors of the Crown arrived at the decision contained therein.

There are many questions upon which the highest legal authorities differ in their opinions, and in a case like the present it would be well for us to ascertain as far as possible the meaning and extent of all legal enactments under which our operations are carried on.

There are certain clauses which relate to timber limits, mining claims, coal lands, grazing lands, colonization companies and other corporate bodies. In all cases where lands have to be surveyed at the expense of individuals or corporations, it is laid down as a condition that the work must be done by a qualified surveyor, as it is clearly defined by act of parliament who may survey Dominion Lands.

I will now enumerate a few branches of our profession which we may investigate with profit to ourselves in addition to the methods of laying out land and dividing it into sections or lots.

We may consider Railway and Road Surveys, Topographical Surveying, including the best methods of delineating the surface of the earth, its various elevations and depressions, and the instruments best suited for the purpose and Hydrographic Surveying, which is of the greatest importance to navigation.

When connected with the Survey of coasts, harbors, lakes and rivers the Hydrographic Survey includes a Topographic one of the land, as well as all particulars in regard to depth, and location of rocks, the velocities and directions of currents, the material found beneath the water, and other information, making an extensive and interesting subject for some of our members to acquaint themselves with.

Mining Surveying differs chiefly from that of ordinary land surveying in the fact that the operations have to be mostly carried on underneath the surface of the ground, and must be conducted with the greatest possible care, so that the exact position of each chamber, tunnel, and drift be known.

As the mines in British Columbia, the Northwest and other parts of our Dominion are developed, which will be the case before many years, this field will offer employment to quite a number more than are now engaged in the work.

Some might turn their attention to Geodetic Surveying, which we trust ere long will be one of the requirements.

We hope that the astronomical work which has been carried on during the last two years by Mr. Klotz, Mr. King, Mr. Ogilvie and others will be permanently continued, and that from the basal points established the trigonometrical work will be carried on until the geographical position of every important locality in the country shall have been determined, and points of reference shall have been fixed, which shall insure the future of the country against the errors which prevail to so great a degree in the older parts of the provinces that it is impossible, until something is done, to get anything like a correct map of the country.

The subject of City Surveying, including water supply, sewerage, construction of streets, lighting, and scores of other matters of the greatest importance, all fall within our sphere, and we would do well to occupy the field.

Let us try and "spread ourselves," gentlemen.

I do not mean in the manner of making a show only, but in something which will have its effect on the progress of our country, which will develop the latent resources of knowledge that so far, in many cases, have been lost with the possessor.

There are many brilliant men in the profession, persons possessing original resources, who in practice have learned many things that would be useful to us all if we could in some way possess ourselves of their knowledge.

Often the ideas thrown out by one individual are carried into effect and improved upon by some one else.

It might appear to you that it would not be fair that I should reap the benefit of your experience in some new line, and in that way compete on equal ground with yourself.

Not so! Whatever you do, if you discover some method of carrying on the work that you find valuable to yourself, don't die and let that knowledge perish with you; give it to us in the shape of a paper, leave a monument behind you, that you may live in the future.

I trust that this Association will develop itself into one of the great scientific institutions of our land, and that what progress has been made since the conception of the idea which gave origin to it, will scarcely foreshadow the dimensions to which it will in a few years attain.

When first the Dominion Land Surveyors Association was formed, there were only a few similar bodies on the continent of America; now we find organizations of the same kind in nearly every one of the United States of America, and representatives of the various institutions have many of them written our Secretary desirous of intercommunion with us in exchanging reports and visiting each other's meetings.

Some of these reports which I have received during the last two years, through interchange with the Association of Provincial Land Surveyors for the Province of Ontario, show that these institutions are flourishing in the States, and there is no reason that I can discern why this Association should not take a leading position amongst similar bodies on the continent. I am ready, gentlemen, to co-operate with you in carrying into effect this idea.

It may not be much that I can do to assist, in comparison with what some of you can accomplish, but if we all unite determined to succeed we will certainly reap the benefit. No effort which we make in this direction will be lost. Our motto, "promote the interests and raise the standard of the profession," should be the object ever kept before us. Not with the idea that such a course will at once repay us in dollars and cents. I despise the man who will do nothing for his country or for any cause whatever until he ascertains how he will be paid.

We may content ourselves with the thought that whatever sacrifice we may make in perfecting this Association will not be lost.

We know that whatever knowledge we may acquire through preparing professional and scientific papers will be a possession to ourselves and enlarge our capacity for usefulness.

As I have prepared a paper on a special subject which will be given at a later stage of the meeting, I do not want to discuss any particular point in this address, but to make it as far as possible a rallying cry, and say, "Gentlemen, the whole field is open. Shall we possess it, and absorb the best talent our country affords, or shall we leave to others what we have already begun?"

This is a question worthy of your consideration.

The more I think about it the more important it seems to me.

All we have to do is to determine individually to do something.

Let us organize so as to work systematically, and our success will be assured.

And now, Gentlemen, let me again thank you for the honor conferred upon me, during the two years past, by permitting me to occupy the presidential chair.

I shall always hold this kindness and token of your respect in grateful remembrance.

THOMAS FAWCETT,
President.

The Secretary-Treasurer read Mr. Wm. Ogilvie's Paper, entitled "The Yukon River and its Sources." The paper and the discussion that followed will be found further on.

The following resolutions were the outcome of this paper and the discussion upon same.

Resolution No. 9.

Moved by J. S. DENNIS, seconded by W. F. KING, and *Resolved :*

That the officers of the Association be appointed a Committee to consider the subject of the naming of geographical features in newly explored country, and the adoption of names generally, for publication on Government maps; and that the officers of the Geological Survey, Captain Boulton and the Surveyor General, be asked to assist the Committee in preparing a Memorandum on this subject, to be printed in the Annual Report and submitted to the Government, if thought advisable by the Committee.

Resolution No. 10.

Moved by G. B. ABREY, seconded by WILLIAM DREWRY, and *Resolved :*

That the thanks of this Meeting be tendered and forwarded to Mr. William Ogilvie for his paper on the Yukon River and its sources.

Resolution No. 11.

Moved by G. B. ABREY, seconded by W. F. KING, and *Resolved :*

That the thanks of this Association be tendered to the members of the Geological Survey and to Commander Boulton for their valuable criticisms and remarks on Mr. Ogilvie's paper and the suggestions arising therefrom; and that this Association tender them an invitation to attend the remaining Sessions of this Annual Meeting.

Evening Session.

The meeting was called to order at 7.30 p.m. E. J. RAINBOTH, Vice-President, in the Chair.

A PAPER, "The placing of permanent marks in the field, as a means to preserve information afforded by Public Surveys," by S. L. BRABAZON, D.L.S., was read and discussed, and finally referred to a standing committee.

A PAPER, entitled "British Government Surveys," by STAFF COMMANDER BOULTON, R.N., followed.

Resolution No. 12.

Moved by W. F. KING, seconded by J. S. DENNIS, and *Resolved :*

That a cordial vote of thanks be tendered Commander Boulton for his paper on British Government Surveys.

Resolution No. 13.

Moved by T. D. GREEN, seconded by J. A. BELLEAU, and *Resolved:*

That a vote of thanks be tendered Mr. Brabazon for his able and interesting paper on the Permanent Marking of Public Surveys.

After an interesting verbal introduction, Prof. Macoun read a very practical paper, entitled "Natural History in connection with the Topographical Survey."

At the close of this paper the following resolutions were passed:

Resolution No. 14.

Moved by J. S. DENNIS, seconded by JOHN MCAREE, and *Resolved:*

That after having heard the able and instructive paper read by Prof. Macoun on the subject of Natural History in connection with survey work, it is the opinion of this Association, that all large exploration or Geodetic Survey parties, sent out by the Government, should be accompanied by a person whose duties should consist of collecting all information and specimens which might be of use from a natural history standpoint, and that the Secretary-Treasurer be instructed to forward a copy of this resolution to the Minister of the Interior, the Minister of Public Works, the Minister of Railways and Canals, and the Minister of Marine and Fisheries.

Resolution No. 15.

Moved by G. E. MCMARTIN, seconded by JOHN MCAREE, and *Resolved:*

That a cordial vote of thanks be tendered the learned Professor Maconn, for his able, interesting and instructive paper on Natural History, in connection with the Topographical Survey.

Resolution No. 16.

Moved by W. F. KING, seconded by J. S. DENNIS, and *Resolved:*

That the Secretary-Treasurer be instructed to have a note inserted in the Annual Report of Proceedings, calling the attention of Surveyors to the paper of Prof. Macoun, and requesting them to do all in their power to assist the furtherance of Natural History, by collecting specimens and forwarding them to Prof. Macoun.

FRIDAY, March 16th.

Morning Session.

The meeting was called to order at 10.30 a.m. E. J. RAINBOTH, Vice-President, in the Chair.

The Committee on Memorial, setting forth a scheme for the inception of a Geodetic Survey in Canada, reported that no action had been taken in the matter.

Some discussion ensued as to the advisability of continuing the agitation.

W. F. KING proposed that a committee should be appointed to consider the matter forthwith, and accordingly the following resolution was passed:

Resolution No. 17.

Moved by T. D. GREEN, seconded by JOHN MCAREE, and *Fesolved:*

That the Vice-President, Otto J. Klotz, W. F. King, J. S. Dennis and Wm. Drewry be appointed a committee to take such necessary steps as they deem advisable, in order to bring before the Government the urgent necessity of a Geodetic Survey of the Dominion being made; and that this Committee should if possible report to the meeting before its close.

Unfinished business brought forth the matter of members whose dues to the Association were in arrears, and after much discussion a resolution was passed as follows:

Resolution No. 18.

Moved by J. S. DENNIS, seconded by C. T. SYMMES, and *Resolved:*

That in reference to those members of the Association who are in arrears of dues, the Secretary-Treasurer be hereby instructed to forward to all such members a notice of proceedings of this meeting, with a short statement of what it is intended to do during the coming year, and notifying them that if they pay up 50 per cent. of the outstanding fees with the fees for the current year, they will be provided with copies of the annual report of proceedings and the exchanges, and in default of their availing themselves of this offer before the first of May next, their names will be struck off of the membership roll.

The Election of Officers for the ensuing year was as follows:

For *President*, E. J. RAINBOTH, without opposition.

For *Vice-President*, JOHN MCAREE, without opposition.

For *Secretary-Treasurer*, A. O. WHEELER, unanimously.

Resolutions Nos. 19 and 20 were then passed.

Moved by T. D. GREEN, seconded by G. B. ABREY, and *Resolved*:

That the Secretary-Treasurer for the past year be presented with $20 00 for the energy and enthusiasm displayed by him in his endeavours to make this Meeting a decided success, and thus further the interests of the Profession.

Moved by J. S. DENNIS, seconded by OTTO J. KLOTZ, and *Resolved*:

That a cordial vote of thanks be tendered the Secretary-Treasurer for the very able manner in which he has conducted the affairs of the Association, and the great interest he has displayed, and the large amount of time he has devoted towards making the Association a success.

On the following resolutions the Executive Committee and Auditors were elected:

Resolution No. 21.

Moved by T. D. GREEN, seconded by WM. DREWRY, and *Resolved*:

That Thomas Fawcett, J. S. Dennis, and Thomas Breene be elected to act on the Executive Committee of the Association for the ensuing year.

Resolution No. 22.

Moved by J. S. DENNIS, seconded by JOHN MCAREE, and *Resolved*:

That T. D. Green and G. E. McMartin be elected to act as Auditors for the ensuing year.

The Morning Session was brought to a close by Resolution No. 23.

Moved by J. S. DENNIS, seconded by OTTO J. KLOTZ, and *Resolved*:

That the Executive Committee be instructed, and are hereby empowered to appoint Standing Committees to consist of three members, to consider and report on the following:

1 Instrument.
2 Geodetic Survey.
3 Publication.
4 Land Surveying.
5 Natural History and Geology.
6 Permanent Marking of Surveys.
7 Photography as applied to Topographical Exploration.
8 Topographical Surveying.

Afternoon Session.

The Committee, to consider amendments to the Constitution, met at 2 p.m.

The meeting was called to order at 3 p.m. E. J. RAINBOTH, President, in the Chair.

J. S. DENNIS read a letter from Mr. John B. Simpson, son-in-law of the late Andrew Russell, Esq., of Ottawa.

Also, biographical sketches of Mr. Andrew Russell, and Mr. H. H. Stephens, of Owen Sound, deceased.

In this connection was passed Resolution No. 24.

Moved by J. S. DENNIS, seconded by JOHN MCAREE, and *Resolved :*

That the Secretary-Treasurer be instructed to convey to the families of Mr. Andrew Russell and Mr. H. H. Stephens the condolences of the Association.

A Paper, entitled "Map Making," by J. H. BROWNLEE, of Brandon, was read by the Secretary-Treasurer.

T. D. GREEN read an interesting Paper, "Mining in British Columbia," by THOMAS DRUMMOND, of Kamloops, B.C.

JOHN MCAREE read a practical paper on the "Relations between Master and Man on a Survey Party," and a lengthy and interesting discussion followed, closed by

Resolution No. 25.

Moved by J. S. DENNIS, seconded by T. D. GREEN, and *Resolved :*

That the subject of Mr. McAree's paper, on "Relations of Master and Man on a Survey Party," be referred to the Standing Committee on Land Surveying, for report at the next Annual Meeting as to the advisability of adopting some scheme of rules and regulations regarding the above mentioned relations.

Mr. MCAREE signified his satisfaction at this course.

The afternoon session was brought to an end by Resolutions Nos. 26 and 27, as follows :

Moved by G. B. ABREY, seconded by R. C. LAURIE, and *Resolved :*

That the Secretary-Treasurer be instructed to convey the regrets of this Meeting to our Ex-President for his unavoidable absence from the Meeting.

Moved by G. B. ABREY, seconded by WM. DREWRY, and *Resolved :*

That this Association tender a vote of thanks to Dr. Dawson, Capt. Deville, Commander Boulton, Dr. Bell, and Mr. J. B. Tyrrell, for the exhibition of photographs, and other articles kindly loaned for our instruction and entertainment, and that the Secretary-Treasurer send a copy of this resolution to each of the gentlemen mentioned.

Evening Session.

The meeting was called to order at 7.30 p.m. E. J. Rainboth, President, in the Chair.

The Committee appointed to consider amendments to the Constitution reported as follows :

MEMORANDUM OF AMENDMENTS TO CONSTITUTION.

ARTICLE III.

(1) The Association shall consist of active members, honorary members and associate members.

(2) Active members must be Dominion Land Surveyors, and only such shall hold office.

(3) Any Dominion Land Surveyor may become an active member upon payment of the fees prescribed by Article X.

(4) Honorary members must be nominated by two active members, and the nomination approved by a unanimous vote of the Executive Committee. The nomination, with approval, must be in the hands of the Secretary-Treasurer at least one month before the Annual Meeting. Persons nominated for honorary membership shall submit a paper to be read at the Annual Meeting.

They shall be elected by ballot in manner hereafter provided for election of officers of the Association. The number of honorary members shall not at any one time exceed twenty, and they shall be exempt from payment of dues.

(5) (*a*) Associate members shall be those who are not Dominion Land Surveyors by profession, but whose pursuits, scientific acquirements or practical experience qualify them to co-operate with Dominion Land Surveyors in the advancement of professional knowledge.

(*b*) Provincial Land Surveyors of any Province and articled pupils of Dominion and Provincial Land Surveyors shall be elgible as associate members.

(*c*) Associate members shall be nominated by one active member in writing to the Secretary-Treasurer, and on approval of such nomination by the Executive Committee shall at once be admitted upon payment of fees prescribed by Article X.

Associate Members shall not vote.

ARTICLE IV.

Sub-clause 4, to be expunged, and following inserted:

(4) Nominations for officers of the Association shall be made to the Secretary-Treasurer, in writing, by two active members, at least two months before the Annual Meeting. The Secretary Treasurer shall prepare and forward ballot papers to the members of the Association, who shall return them marked in sealed envelopes to the Secretary-Treasurer before the date of the Annual Meeting.

(5) The letter ballots shall be opened at the Annual Meeting, and the majority of the ballots cast in each case decide the election.

(6) In case of an even or tie vote, the election shall be decided by the members present at the Annual Meeting voting by ballot.

(7) Should the Secretary-Treasurer not receive three nominations for each of the offices of President, Vice-President, or Secretary-Treasurer, or six nominations for members of the Executive Committee, the Executive Committee shall add to the ballot paper a sufficient number of names to make up the number of three candidates for each of the offices and twelve for the Executive Committee.

ARTICLE V.—Expunged.

ARTICLE VI.

Clause 3, amended by substituting 11 for 5 members to form a quorum.

Amend sub-clause (1), by omitting "general meeting in Winnipeg."

ARTICLE VII.—Amended.

In sub-clause 2, omit all after *general meeting* in second line, and insert, "and such amendment shall be voted upon at the said Annual Meeting, two-thirds majority of the votes cast being necessary for its adoption."

ARTICLE X.

Amended by expunging sub-clause 2, and inserting:

The fees of active members shall be forwarded to the Secretary-Treasurer, with the ballot paper for election of officers, and any ballot unaccompanied by the fees mentioned in sub-clause 1 shall not be counted in the election.

(3) Associate Members shall pay a fee of two dollars annually.

Resolution No. 28.

Moved by J. S. Dennis, seconded by G. B. Abrey, and *Resolved :*

That the clause of the Constitution regarding amendments be hereby suspended and that the report of the Committee on Amendments required to the Constitution be received and adopted.

The appointment of the Standing Committees for the year was announced by the President.

W. F. King, Chief Inspector of Surveys, read a paper, entitled ‘ Some Methods of Determining Geographical Positions."

Otto J. Klotz read a most interesting paper on " Electrical Apparatus in Longitude Work," the paper being practically illustrated by the instruments used in actual determination.

It was arranged that the Committee appointed to consider the question of a Trigonometrical Survey of the Dominion should meet the next day, Saturday, 17th inst., at 2.30 p.m.

Also, that the Executive Committee should meet on the same day with regard to the question of Geographical Orthography and Nomenclature.

It was then moved by Otto J. Klotz, seconded by John McAree, and *Resolved:*

That the meeting adjourn until the third Tuesday in February of 1889.

* * *

NAMES OF MEMBERS PRESENT.

Honorary Members.

W. F. King, D.T.S., Chief Inspector of Surveys;

Alfred R. C. Selwyn, C.M.G., LL.D., Director of the Geological Survey of Canada.

George Mercer Dawson, D.Sc., Associate R.S.M., Assistant Director of the Geological Survey of Canada.

Robert Bell, B.A.Sc., C.E., M.D., Assistant Director of the Geological Survey of Canada.

Prof. John Macoun, M.A., F.L.S., Assistant Director of the Geological Survey of Canada.

Staff Commander J. G. Boulton, R.N.

Active Members.

Abrey G. B.
Beatty Walter,
Belleau J. B.
Bigger C. A.
Breene Thomas,
Dennis J. S.
Drewry Wm. S.
Driscoll Fred.
Green Thos. D.
Klotz Otto J.
Laurie R. C.
McAree John,
McLatchie John,
McMartin G. E.
Rainboth E. J.
Rauscher R.
Snow J. A.
Symmes C. T.
Wheeler Arthur O.

Visitors.

J. B. Tyrrell, Geological Survey,
Jas. McEvoy, " "
Jas. White, " "
P. B. Symes, Dept. of the Interior,
J. H. O'Hanley " " "
J. Macara, " " "
Arthur Genest, " " "

NEW MEMBERS.

Honorary.

Staff Commander J. G. Boulton, R.N., London, Eng.

Prof. Galbraith, School of Practical Science, Toronto, Ont.

Active.

William Drewry, D.L.S.	Belleville, Ont.
R. C. Laurie, D.L.S	Battleford, N.W.T.
Henry W. Selby, D.L.S	Stayner, Ont.
J. A. Belleau, D.L.S	Ottawa, Ont.
Fred. Driscoll, D.L.S	Aylmer, Que.
J. H. Brownlee, D.L.S	Brandon, Man.
Geo. Montague-White, D.L.S	Toronto, Ont.
H. J. Bowman, D.L.S	Berlin, Ont.
W. Gordon Forlong, D.L.S	Montreal, Que.
Chas. T. Symmes, D.L.S	Aylmer, Que.
Louis B. Stewart, D.L.S	Banff, N.W.T.
H. De Q. Sewell, D.L.S	Port Arthur, Ont.
Chs. Eug. Bourgault, D.L.S	St. Jean Port Joli, Que.

Associate.

Eugene Coste	Geological Survey, Ottawa,
William H. Chatterton Smith	Geological Survey, Ottawa.
Alfred E. Barlow	Geological Survey, Ottawa,
D. B. Dowling	Geological Survey, Ottawa,
Louis N. Richard	Geological Survey, Ottawa,
Henry P. Brumell	Geological Survey, Ottawa,
James White	Geological Survey, Ottawa,
James McEvoy	Geological Survey, Ottawa,
Arthur Stephen	Sault Ste. Marie, Mich.

NOTE.—This list is complete to June 1st, 1888. For full names, diplomas and addresses, see list of members at end of Report.

Those wishing to become Associate Members of the Association will please to forward their names, recommended by any one active member, to the Secretary-Treasurer, who will submit the same to the Executive Committee for approval.

Obituary.

To the President and Members of the Dominion Land Surveyors Association.

Gentlemen,

Among the many changes which time brings are those caused by death among the members of our profession. I wish briefly to refer to two of our brother surveyors who have passed away since our last meeting.

Mr. Andrew Russell, in many ways the father of our profession in Canada, died at Toronto on Friday, the 24th of February last, at the ripe old age of eighty-five.

He was born in Glasgow, Scotland, and entered active life in this country in 1829. His life up to within a few years of his death was one of busy employment, and he filled many important positions of trust. Who among us but has experienced his extreme kindness and never failing courtesy, and his willingness to entertain with reminiscences of surveying in his early days. A few years since an address was presented to him by this Association which fully set forth the feelings of the members, so I will close this short sketch by remarking that any profession would be honoured by having had among its members a man like Mr. Russell, whose name was synonymous with honesty and true christianity.

Another member of our profession who has passed away is Mr. H. H. Stephens, of Owen Sound, who died at Lindsay on the 16th September last. He had contracted a severe cold while engaged in surveying operations, and suffered for many months before his death.

He was a Provincial Land Surveyor for Ontario, and becoming a Dominion Land Surveyor in 1883, conducted contract Surveys in the Northwest during the years 1883 and 1884, and had since been carrying on a local practice in Ontario. He has passed away after faithfully performing his duty during a number of years of professional life, and what higher praise can be bestowed on any man than to say " he performed his duty well."

J. S. DENNIS.

LETTER FROM MR. ANDREW RUSSELL'S SON-IN-LAW.

344 Maria Street,
OTTAWA, March 12, 1888.

J. S. DENNIS, Esq.

MY DEAR SIR,

I received your kind note of last week, and before giving you the data you asked for, I wrote Mrs. Russell for her consent, knowing, as I did, Mr Russell's antipathy to anything of the sort. Mrs. Russell, in reply, desires me to convey to the Dominion Land Surveyors Association her deep sense of their great kindness and appreciation of Mr. Russell's public life and service, so beautifully expressed in their testimonial. It was so gratifying—yes, comforting, to him during his years of feeble health, when unable to take part in those scientific pursuits he loved so well.

The recipient of your testimonial, if alive, would only ask in a similar case to have it recorded "that one of our members has gone before." Let it be so in his own case.

And believe me, yours respectfully,

JOHN B. SIMPSON.

* * *

REPORT OF SECRETARY-TREASURER.

To the President and Members of the Dominion Land Surveyors Association.

Gentlemen,

I have the honor to lay before you the report of proceedings during the past year, and venture to make a few suggestions for the coming one.

Reports of the United States Coast and Geodetic Survey to date were applied for on behalf of the Association, and were received from the years 1871 to 1885 inclusive, also copies of the "Coast Survey Regulations," "Report of the American Association for 1857," "Historical Sketch of Coast and Geodetic Survey," and "Notes on Transfer of Coast Survey, by Admiral Jenkins, U.S. Navy." These volumes have been placed in the library of the Association.

Two hundred copies of the report of proceedings at the last Annual Meeting were printed and distributed to the members of the Association and gentlemen interested in the doings of the same.

A request by circular was sent to each active member and by special letter to each honorary member, asking them to prepare a paper on some suitable scientific topic to be read before the meeting. The results may be seen in the programme.

I would suggest that in future no honorary member be admitted to our roll, until he has shown himself worthy of such election by preparing a paper to be approved at the Annual Meeting. I believe the Royal Society adopts this method in the election of ordinary members.

With regard to future exchanges. I have written during the year to the Surveying and Engineering Associations and Societies of Missouri, Illinois, Nebraska, Connecticut, Michigan, Ohio, Indiana and Colorado, asking their views with regard to an exchange. Replies were received from the Societies of Michigan, Ohio, Illinois, Connecticut, and Colorado, all expressing not only willingness but in some cases anxiety to do so.

I regret to have to mention that death has made two blank spaces in our membership roll, Andrew Russell, Esq., of Ottawa, and H. H. Stephens, Esq., of Owen Sound.

Another serious matter claims your attention, viz., what is to be done with members in arrears? A great many of the arrears go back as far as the year 1885, the sum total amounting to over $250.00. That the annual dues should have got into such a state of backwardness must be largely owing to the fact that the payment of fees has not been properly looked after.

By the appended statements of receipts and expenditures for the last two years, you will see that we have a balance on hand of $243.26.

It now rests with you to say what price shall in future be set upon each copy of the proceedings of our Association. Numerous applications were received during the past year, and I was at a loss to know how to charge for them.

There are a number of Provincial Land Surveyors, Civil Engineers, and other gentlemen, practising and taking an interest in surveying, who would be glad to join us as Associate Members, did our constitution admit of such membership. Independently of the assistance and strength these members would lend to us, they would materially add to the financial resources of the Association.

Numerous enquiries have been made by members wishing to attend the meeting, as to whether reductions in railroad fares could be obtained, and it would be well that in future such a concession should be sought from the different roads likely to be used. I believe it is customary to give the return fare at one-third and for the Association or Society to issue a certificate entitling to such reduction.

In conclusion I would like to draw your attention to the fact, that the valuable collections of photographs now on exhibition have very kindly been loaned by our Honorary President, Capt. E. Deville, Surveyor General, and by Dr. Dawson, Dr. Bell, and Mr. J. B. Tyrrell, of the Geological Survey, and this mark of the interest these gentlemen take in our affairs deserves our warmest thanks. I may further state that the views have been taken by the gentlemen themselves.

I have the honor to be, Gentlemen,
Your obedient servant,
ARTHUR O. WHEELER,
Sec.-Treas.

RECEIPTS AND EXPENDITURES

For year extending from February 16th, 1886, to March 8th, 1887:

Receipts.

By Balance on hand	$274 08	
" dues for current year	58 00	
		332 08

Expenditures.

To rent of room for Annual Meeting	$ 5 00	
" Lithographing for Annual Report	25 00	
" Postage	2 00	
" Secretary-Treasurer for services	20 00	
		52 00
Balance on hand	$280 08	

For year extending from March 8th, 1887, to March 14th, 1888:

Receipts.

By balance on hand	$280 08	
" Arrears of dues for 1885	4 00	
" " " 1886	14 00	
" Dues for 1887	69 00	
" " 1888	13 00	
" Advertisements in Annual Report	30 00	
" Sale of Annual Reports	50	
		410 58

Expenditures.

To Rent of room for Annual Meeting	$ 5 00	
" Type writing	1 65	
" Lithographing for Annual Report	10 00	
" Printing	147 50	
" Postage	1 67	
" Stationery	1 25	
" Telegrams	25	
		167 32
Balance on hand	$243 26	

AUDITOR'S REPORT.

J. S. Dennis reported on behalf of the auditors that the accounts of the Association, for the years 1886 and 1887, as presented by the Secretary-Treasurer, had been duly examined, and had been certified to as correct.

NOTICE OF SIXTH ANNUAL MEETING.

The Sixth Annual Meeting of the Association will take place at Ottawa, commencing on the third Tuesday in February, 1889.

It is hoped that the necessary arrangements, to enable members to travel to and from the place of meeting at reduced rates, will be made with the several Railroads.

Members of the Association are urged most earnestly to lend their assistance towards making this meeting a success, and to cooperate as far as possible with the Committees having the matters to be presented at the same in hand.

A circular will shortly be issued, asking the members individually to prepare a paper to be then read, or to bring some matter of interest to the profession, before the meeting, and it is sincerely hoped that those in a position to fulfil this request will not be found wanting.

Queries, problems or data, relating to any of the subjects on which standing committees have been appointed, if sent to the Secretary-Treasurer, will immediately be forwarded to the Chairman of the Committee concerned, or can be sent direct to the Chairman of such Committee.

Remember ! every little helps, and that any encouragement, no matter how slight, is a great assistance to those who are working for the welfare of the Association.

NATURAL HISTORY NOTICE.

In accordance with Resolution No. 16, passed at the Fifth Annual Meeting of the Association, special attention is called to Professor Macoun's paper on Natural History, in connection with the Topographical Survey (to be found farther on). All members of the Association and Surveyors, or others whose chances are abundant, and who may read these pages, are particularly requested to do all in their power to assist in the furtherance of the Science of Natural History, and to lose no opportunity of collecting specimens and forwarding them to Professor Macoun at the Geological and Natural History Museum of Canada, Ottawa, Ont.

At the close of Professor Macoun's paper will be found practical instructions, for preparing and preserving the skins of small animals and birds, issued by Dr. C. Hart Merriam, of Washington, D.C.

This appeal is made in view of the fact, that the Surveyor, in the prosecution of his profession, is rendered more than usually liable to meet with species or classes of the smaller mammals or of reptiles, that will if procured be not only interesting but extremely valuable from a scientific point of view.

Memorandum.

Prepared by a Committee appointed at the Fifth Annual Meeting of the Dominion Land Surveyors Association, held at Ottawa, March 15th and 16th, 1888, to consider the question of a Trigonometrical Survey of the Dominion, to draft a scheme for its inception, and to take such steps as they might deem advisable to bring the subject under the notice of the Government, and of others likely to be interested in this much needed work.

The Committee beg to submit the following in reference thereto:

The Dominion has now arrived at that stage when the wants of the country demand a more exact system of survey than that in vogue.

The question of the value and utility of a trigonometrical survey has been so settled by almost every civilized nation, that it is hardly necessary to advance proof of the statement that it would be of immense practical value to the whole Dominion; but for illustration, and in support of the statement, the following facts are offered.

The surveys of this kind, which have been made by other countries, may be briefly referred to.

First and foremost is the Ordnance Survey of Great Britain and Ireland, covering nearly 111,000 square miles, which was begun in 1784 and is now nearing completion. Then comes the great Trigonometrical Survey of India, inaugurated at the beginning of the present century by Colonel Lambton, which is still in progress, and of which the beneficial results have been inestimable. Belgium is carrying on a survey which, when completed, will furnish 450 sheets of map on a scale of $\frac{1}{20,000}$ with contour lines one metre apart.

Prussia is carrying on an extensive survey, and since 1849 has introduced new and more perfect methods. Russia, with its enormous territory, about twice the size of the United States, including Alaska, has been for many years engaged in prosecuting trigonometrical surveys.

Norway, although a comparatively poor country, has set itself on having a good topographical map, on a scale of $\frac{1}{10,000}$ compiled from trigonometrical surveys.

Austria has completed a new map of the Empire, comprising 715 sheets also compiled from data furnished by trigonometrical surveys.

Denmark, Switzerland, Spain, Portugal and Italy are all carrying on trigonometrical surveys, to enable them to map their territories accurately.

France has completed her survey, and the result is shown in 276 sheets of map.

On this continent surveys of a high order of precision have been made by the United States Government, and the work of the Coast and Geodetic Survey is going steadily on, having been extended along the sea coast and also along the Great Lakes, and many of the States and Territories have been covered by its operations, including some in the far West, viz. : Nevada, Colorado, Utah, New Mexico, Montana, Idaho and part of Arizona.

Several of the states have conducted independent trigonometrical surveys of their own territory, including Massachusetts, California, New Jersey and New Hampshire, and in other states they are in progress.

All the foregoing surveys are based on triangulation.

It may be asked what are the practical benefits to be derived from a trigonometrical survey, and what is there to justify the expenditure of the large sum of money which a survey of this kind would ultimately cost. To make the point of practical benefit clear, the following will be readily understood by all :

It is stated by an eminent American Engineer that "if the State of Massachusetts had had a good topographical map in 1836, some $20,000,000 would probably have been saved in its public railway expenditure."

Mr. Sandford Fleming, C.M.G., in his report to the Minister of Public Works, dated April 5th, 1879, says: "If the railways of Ontario had to be established 'de novo,' a careful study of the requirements of that Province would enable any intelligent engineer of ordinary experience to project a new system which at one half the cost would far better serve the public, and would meet every demand of traffic, would more fully satisfy every expectation, and which would not result in disappointment and loss to those who have been induced to invest their means in that which has proved to many an unprofitable undertaking."

If to-day a railroad is projected in England, or any other country possessed of a good topographical map, preliminary surveys such as we are obliged to make are unnecessary, for from these plans the lengths and grades of any proposed line can be determined with sufficient accuracy to enable a final location to be made.

In carrying on a survey of the character contemplated, it is necessary to run lines of exact levels from station to station, and thus we would have the elevations of points all through the settled portions of the country, and in future operations, in which levelling is a feature, all levels could be referred to a common datum line (sea level for instance), and when railway lines are pushed back into the wooded interior, the physical character of which is but little known, we would then have some definite idea of main watersheds and valleys, to guide future operations, instead of relying, as is at present done, on guess work and hearsay evidence.

Among other benefits to be derived from a survey of this kind, are the following: Our extensive coast line both in the Gulf of St. Lawrence, on the Atlantic and Pacific seaboards, and also in our inland waters, has been very roughly determined in many places, and in consequence many disasters happen to shipping, and many valuable lives are lost annually, which would in a great measure be avoided were we in possession of reliable charts of our waters; and one of the first requisites in making the hydrographic surveys, necessary to provide the data or compilation of these charts, is that certain points on the shore should be accurately fixed. It may be mentioned in connection with the Hydrographic Survey of Georgian Bay, at present being carried on under the direction of Staff Commander Boulton, R.N., that Commander Boulton stated before the D. L. S. Association, at its last annual meeting, that in making his survey he had not been able to connect his work, with any point accurately determined by Canadian authority, but had to use points established by the United States Coast and Geodetic Survey.

On our inland lakes and waters large sums are annually spent in harbor and other improvements, and yet the geographical positions of these harbors and waters are not accurately shown on any map or chart.

A large sum has been spent in building the Murray Canal, between Lake Ontario and the Bay of Quinte, but there is no correct chart of the Bay, and a stranger attempting to navigate a deeply laden vessel in its waters would probably meet with disaster. This has happened time and again, and will continue until we have an accurate chart of the Bay, and as has already been said the work of making these charts would be greatly expedited by having points along the shores established by a trigonometrical survey from which to begin the hydrographic survey.

Numerous isolated surveys have been made under various departments of the Government, at points on the Atlantic coast, the Gulf of St. Lawrence, and in the Great Lakes; it is also proposed by the Militia Department to make a series of reconnaissance surveys at different points; all these surveys, made, or to be made, give valuable results, but they cannot be considered complete until they are connected. To this end a carefully executed triangulation is necessary.

Again, with the increase in the value of real property, any work having in view the permanent marking of points which would definitely fix the positions of boundaries of real estate, is for the public good. In many of the Provinces the boundaries of valuable properties are in most cases dependent on the durability of wooden posts, a few marks on trees, or the testimony of a few of the oldest inhabitants, and as a consequence expensive litigation often arises, in fact it may safely be said that the amount annually expended in litigation regarding boundaries would go a long way towards paying for the cost of a trigonometrical survey.

Were the boundaries, especially those of large areas, such as counties, townships, and concessions, accurately defined by a trigonometrical survey, similar to that made by the countries herein referred to, all doubt as to their position would be forever set at rest.

At the present time, throughout the Dominion, every city and many of the towns and villages are looking about for means of obtaining a good water supply or of improving the supply they have.

Gravity being the best method of utilizing a water supply, is generally first sought after, but the information necessary to determine the availability of a supply by this means, can now only be had by expenditure of large sums in surveys, as has been lately seen in Toronto.

Had there been a good topographical map in existence, that expenditure would have been unnecessary.

In drainage work the information derivable from a survey of this kind would be invaluable, and as our agricultural population is waking up to the benefits arising from proper drainage, no time should be lost in giving them this aid. The maps would enable any engineer to determine by a simple calculation the area of any basin to be drained, and to know accurately the size of drain necessary, and its proper location, and the survey would do away with all litigation arising from parties claiming that their lands do not lie in the basin to be drained, as a reference to the map would show at a glance the natural drainage outlet for any piece of land.

These maps would also be exceedingly valuable in assisting an equitable assessment of real estate for taxes, and in providing the necessary information required in locating and building public highways, and would save large sums of money which are now expended in finding out where roads should be built; and the sum so saved might be expended in making the roads more solid and permanent.

The information afforded by the maps provided from a survey of this kind, in reference to our inland waters, and the possibility of their utilization for navigation which is becomng every day of more importance, would be of vast benefit to the country.

Many large public works are now being agitated, and will no doubt in the near future be undertaken, as, for instance, the "Ottawa Ship Canal," the "Trent Valley Canal," etc., the possession of good topographical maps would very naturally assist in settling the question of the feasibility of these and many other schemes for the improvement of navigation, etc.

Instances might be cited indefinitely to prove the value, not only to the Government, but to the people at large of a trigonometrical and accompanying detail survey of the kind herein referred to, but it is thought that enough has been said to conclusively show the benefits which would accrue therefrom.

The survey should be undertaken by the Federal Government, as it is pre-eminently a Dominion work, and we now come to the important point of a basis or scheme for its inception.

In a work of such proportions as a survey of this kind would ultimately assume, it is primarily essential that a well matured and carefully considered scheme be first laid down, upon which to develop the whole; and being guided by the experience of other countries, it is evident that a primary triangulation is necessary as a ground work for all detail surveys.

For the inception of the work, and that a beginning may be made, it is suggested that the work should be commenced on the St. Lawrence River near Cornwall, where the U. S. Lake survey ended, and be continued down that River to the Gulf. The work would first consist of a primary triangulation, with sides of from 10 to 30 miles in length, as circumstances permitted, and would then be extended by carrying on a greater or less amount of interior topographical work, levelling, etc.

COST.

The cost would of course vary with the extent of survey, but it is thought that a sum of, say, $15,000 would be sufficient to start the primary triangulation, which is the basis of survey. This amount would cover the cost of two observers, one on each side of a main chain of triangulation, and two station setting parties, and would pay all expenditure of the above for transport and travelling expenses.

Of course a much larger sum than that mentioned could be advantageously employed, but the annual expenditure of this small amount would provide a large quantity of valuable information, and would lay the foundation for more extensive prosecution of the work, when the circumstances warranted it.

The advantages accruing to the country by a geodetic survey would not be confined to the definite material advantages gained in topographical knowledge, and the coast and sounding surveys based upon the triangulation.

An additional and not inconsiderable advantage would be the stimulus given to scientific research. It has been the experience of other countries that men employed on geodetic surveys, having their attention drawn to the numerous branches of science involved, have, by their scientific and mechanical inventions, added greatly to the sum of knowledge in these branches, and indirectly to the material wealth and progress of the countries.

The Association of Dominion Land Surveyors has long felt that the time had arrived when a trigonometrical survey of the country should be begun, and the question has frequently been discussed at their annual meetings. In 1886 they took action in the matter by preparing a memorial on the subject, and submitted the same to the Hon. the Minister of the Interior; and recognizing the necessity for keeping the matter alive, they appointed this committee, as has already been mentioned, to prepare a memorandum on the subject.

In submitting this memorandum for your consideration, the committee feel that the subject is one which should appeal strongly to all who are interested in the welfare of our Dominion, and they think the facts herein contained should be sufficient to show the necessity for a beginning being made towards a geodetic survey of our country.

They earnestly ask you to do anything you can to assist the Association in bringing this matter to the notice of any who are likely to be interested in seeing this much needed work begun, all of which is respectfully submitted.

W. F. KING,
O. J. KLOTZ,
W. S. DREWRY, } Committee
E. J. RAINBOTH
J. S. DENNIS.

OTTAWA, April 13th, 1888.

* * *

Memorandum,

Prepared by the Executive Committee of the Dominion Land Surveyors Association, in accordance with a resolution regarding Geographical Nomenclature and Orthography in Canada, passed at the Annual Meeting, held at Ottawa, March 15th and 16th, 1888.

In accordance with a resolution regarding the naming of geographical features, passed at the last annual meeting of the Association of Dominion Land Surveyors, the Executive Committee beg to submit the following remarks in reference to the important question of geographical nomenclature and orthography in Canada, and to make certain suggestions regarding the necessary action to correct many of the mistakes and inconsistencies now existing, and to prevent re-occurrence of the same in the future.

The Committee having invited the views of those gentlemen connected with the Government service, who have to do with the naming of geographical features, or the compilation of Government maps, and who are, therefore, in a position to speak intelligently on this point, submit the same as affording most valuable and reliable information in reference thereto.

SUGGESTIONS ON GEOGRAPHICAL NOMENCLATURE IN CANADA.

BY DR. G. M. DAWSON, GEOLOGICAL SURVEY.

" So far as I have been able to discover, no code of rules bear-
" ing on the introduction or use of geographical names in new or
" unmapped country has been authoritatively formulated or con-
" sistently followed. Usage in the matter has been very varied,
" and often quite manifestly very absurd and unjust, both toward
" the native races inhabiting such new countries and to the earlier
" civilized explorers, the names given by whom have too often been
" ignored in consequence of the egotism, ignorance or in some
" cases the sycophancy of later explorers or surveyors. The very
" intricacies of the question and the diversity of circumstances in
" different regions appear to have constituted the chief difficulty
" met with in laying down uniform rules, but it seems that it may
" not be impossible to formulate principles which should be appli-
" cable to the circumstances in so far as the Dominion of Canada

" is concerned. The matter is an important one from a practical " point of view alone, and the fixing of geographical names in the " first instance on published maps carries with it a considerable " responsibility.

" Dr. Egli, from a study of known geographical names, enun- " ciates the following law as the result of his investigations :—

" 'Geographical onamotology, regarded as the intellectual out- " come of a people or of an epoch, represents both the stage " and direction of culture specially characteristic of that onamo- " tological family.' (*Nomina Geographica Leipsic* 1870–73, *quoted in Scottish Geog. Mag., Vol. I., p.* 425.)

" Respecting the orthography of geographical names, however, " some progress has been made, and principles have been recom- " mended which it may be well to follow. The Royal Geographi- " cal Society has adopted (in 1885) a series of rules of which the " essential points, in so far as they are applicable to the particular " question under discussion, may be summarized as follows :

(Journal Royal Geog. Society, Vol. VII, p. 535.*)*

" 'Names which have passed into common usage, whether " correctly rendered or otherwise, should be retained.

" 'Names, such as native names, which have not been committed " to writing in characters of the Roman alphabet, to be spelt " according to sound as nearly as possible.'

" For this purpose definite values are assigned to the letters of " the alphabet, the main features of the alphabet recommended " being as follows :—'Vowels to be pronounced as in Italian, " consonants as in English. An acute accent to mark the sylla- " ble on which stress is laid in pronunciation.'

" The Geographical Society of Paris, about a year later, adopted " rules for orthography which are practically identical with the " above. The alphabets recommended by both societies are also " nearly the same with Gibb's standard alphabet published by the " Smithsonian Institution in 1863, and with that of Major J. W. " Powell (1880), the two last being, however, intended for linguis- " tic purposes. Though any one of these alphabets might be " employed with advantage, I believe that the preference should be " given to the first mentioned, as having been adopted from a " specially geographical standpoint, as being that likely to be " employed for scientific geography in the numerous and widely "scattered regions constituting this Empire, and as being sufficiently precise for the purpose in view, while at the same time "simple.

"In cases of conflicting names applied to the same feature, and "for guidance in selecting those to be definitely perpetuated on "official maps, the underlying rule must, I think, be that of priority. This rule has always been tacitly recognized in geography, "it has been affirmed lately by the Geological Congress, and has "been generally acknowledged in systematic scientific nomenclature. Without entering into a statement of the obvious advantages of such a principle, I may quote the following remarks as "embodying a late pronouncement in its favor from the *Code of* "*Nomenclature and Check List of North American Birds* (1886). "The passage quoted is of course intended to apply specially to "scientific nomenclature in Natural History, but is in most points "equally applicable to the systematic nomenclature of natural "features. 'The general tendency at present is in favor of the "greatest attainable fixity of names, by the most rigid adherence "to the law of priority under all practicable circumstances, and "by the disregard as far as possible of all rules requiring the "rejection of names for faulty construction, for barbarity, for "being meaningless, and even for being literally false.'

"With the facts above referred to in view, and taking also into "account the other considerations which affect the question, I "venture to suggest the following as principles to be observed in "regard to the nomenclature of plans in Canada:

"1. Names of places should be adopted and perpetuated as "they occur where first published on maps or in reports or works "in which the places are described.

"Provided, however, that the mere incidental mention of names "which cannot certainly be localized, or which it may be evident "have been carelessly or casually referred to, may be rejected or "modified.

"Exceptions to this rule may also occasionally and guardedly "be allowed in the case of names which may have become entirely "obsolete, owing to insufficient publication.

"2. Where well recognized English and French equivalents "exist for the names of places, either form may be employed, but "so far as possible that first given to any place should be retained "in its original form; and where reports or works are translated "from English to French, or conversely, the names of places should "not be changed except in the case first mentioned.

"3. In respect to geographical features for which no published "names exist, the names employed by the natives of the district "should be assumed to have priority.

"Exceptions may be made to this rule where traders, settlers, "miners, etc., have applied names which have become locally "known in place of the native names. Also where the native "names are too long or too difficult of pronunciation for convenient use, and where the same names have already been applied "to places in the same or neighboring districts, and are thus "likely to lead to confusion, though the duplication of names of "minor features in widely separated localities cannot in all cases "be avoided, and where they are not likely to appear together "on general maps is scarcely objectionable.

"In the case of the exceptions noted in the above paragraph, "the translations of Indian names may often be adopted with "advantage.

"4. When native names are adopted according to the above "rule, they should be taken in their entirety, and not arbitrarily "mutilated or cut down for the sake of brevity, though the general "term denoting river, lake, etc., may be dropped—e.g. *wapta* "(Stoney), *sipsi* (Cree) meaning river, *sagohequn* (Cree) meaning "lake, etc.

"5. All such native names for the first time published to be "spelt according to sound, in conformity with the alphabet recommended by the Royal Geographical Society.

"6. In all cases where after due enquiry it is found necessary "to apply new names, either owing to the non-existence of "recognized names or to inability to ascertain the native names, "they should be whenever possible of a descriptive character or "have some historical or other potent connection with the district, "all trivial, meaningless or too common names being carefully "avoided.

"7. All names of places in newly explored or surveyed districts "to be approved before publication by the Surveyor General, the "Director of the Geological Survey, or head of any other Department, under which original geographical work may be carried "out; it being understood that the head of such Department "assumes the responsibility of the nomenclature and of the orthography of names.

EXTRACT FROM LETTER OF THE SURVEYOR GENERAL, DATED 3RD APRIL (INSTANT.)

"In reply I beg to say that this subject was already discussed "between Dr. Dawson and myself, and that I concur in the views "which he expressed and which he has, I presume, already sub-"mitted to the Association. I will merely add a few remarks.

"In the first place, I believe that the privilege of giving names "should be used as sparingly as possible. Whenever it is possible "to ascertain the name used by the inhabitants of the country or "given by former explorers, it should be preserved, unless it be "such as to create confusion, in which case it should be either "slightly altered or changed altogether.

"In the next place, I am of opinion that except in the case of "unpronouncable Indian names, translations should not be "made. This should be an absolute rule for personal names. I "might cite instances in which the non-observance of this rule "has been the cause of confusion and ludicrous mistakes.

"When a name has to be given, I think that it should be one "suggested by the natural features of the ground or surrounding "country, in preference to any other; where no peculiarity exists, "then the name of some distinguished person or remarkable occur-"rence, this to be left to the judgment of the explorer.

EXTRACT FROM LETTER OF STAFF COMMANDER BOULTON, R.N., DATED MARCH 26TH (INSTANT).

"I have the honor to submit the following:

"1. That there should be a Government Officer from whom "Surveyors could ascertain if the geographical feature they are "about to name *already possesses one.*

"2. This curator should possess a copy of every Federal and "Provincial Government map or chart, should have a good "knowledge of French and the Indian languages, so that he may "be an *authority* for the correct orthography of any names "surveyors may give or report in their maps or charts.

"3. That when Indian names are given, the syllabic system by "hyphens should be adhered to as "Ma-ni-to-wa-ning."

"4. That when native names are given, the English translations "should be bracketted in alongside of them, if there is room.

"5. When Indian names are considered to be too long for "practical use, their English equivalents should be used instead.

"I append hereto for the consideration of the Association a "system of orthography issued by the Admiralty for the guidance "of Admiralty Surveyors abroad :—

SYSTEM OF ORTHOGRAPHY.

1. All geographical names in countries which use the Roman character should be spelt as by the respective nations, or as generally recognized by Englishmen. In some cases both forms may be necessary, thus, Livorno (Leghorn).

2. Names in countries which do not use the Roman character are to be spelt after the following system, except in such cases as by long usage have become familiar to English eyes, thus Calcutta, Cutch, Celebes, Mecca, and similar words, should be written as heretofore.

3. The true sound of the word as locally pronounced will be taken as the basis of the spelling.

4. An approximation of the sound is alone aimed at. A system which would attempt to represent the more delicate inflections of sound and accent would be so complicated as only to defeat itself

5. The broad features of the system adopted are that vowels are pronounced as in Italian and consonants as in English.

6. One accent only is used, the acute, to denote the syllable on, which stress is laid. This is very important. as the sounds of many names are entirely altered by the misplacement of this "stress."

7. Every letter is pronounced. When two vowels come together each one is sounded, though the result, when spoken quickly, is sometimes scarcely to be distinguished from a single sound, as in *ai*, *au*, *ei*.

The amplification of the rules is given below :—

Letters.	Pronunciation and Remarks.	Examples.
a	*ah*, *a* as in *father*	Java, Banâna, Somâli, Bari,
e	*eh*, *e* as in *benefit*	Tel-el-Kebîr, Oléleh, Yezo, Levúka, Peru.
i	English *e ;* *i* as in *ravine ;* the sound of *ee* in *beet* . Thus, not *Feejee*, but	Fiji, Hindi.
o	*o* as in *mete*	Tokio.
u	long *u* as in *flute ;* the sound of *oo* in *boot*.	
	oo or *ou* should never be employed for this sound. Thus, not *Zooloo* or *Zoulou*, but	Zulu, Sumatra.
	All vowels are shortened in sound by doubling the following consonant.	Yarra, Tanna, Mecca, Jidda, Bonny.
	Doubling of a vowel is only necessary where there is a distinct repetition of the single sound.	Nuulúa.

Letters.	Pronunciation and Remarks.	Examples.
ai	English *i* as in *ice*	Shanghai.
au	*ow* as in *how* . Thus, not *Foochow*, but	Fuchau.
ao	is slightly different from above .	Macao.
ei	is the sound of the two Italian vowels, but is frequently slurred over, when it is scarcely to be distinguished from *ey* in the English *they*.	Beirût, Beillû.
b	English *b*.	
c	is always soft, but is so nearly the sound of *s* that it eshould b seldom used.	Celebes.
	If *Celebes* were not already recognized it would be written *Selebes*.	
ch	is always soft as in *church* . .	Chingchin.
d	English *d*.	
f	English *f*. *ph* should not be used for the sound of *f*. . Thus, not *Haiphong*, but	Haifong, Nafa.
g	is always hard. (Soft *g* is given by *j*)	Galápagos.
h	is always pronounced when inserted.	
j	English *j*. *Dj* should never be put for this sound.	Japan, Jinchuen.
k	English *k*. It should always be put for the hard *c*. . Thus, not *Corea*, but	Korea.
kh	The Oriental guttural . . .	Khan.
gh	is another guttural, as in the Turkish	Dagh, Ghazi.
l m n	As in English.	
ng	has two separate sounds, the one hard as in the English word *finger*, the other as in *singer*. As these two sounds are rarely employed in the same locality, no attempt is made to distinguish between them.	
p	As in English.	
q	should never be employed ; *qu* is given as *kw*	Kwangtung.
r s t v w x	As in English.	Sawâkin.
y	is always a consonant, as in *yard*, and therefore should never be used as a terminal, *i* or *e* being substituted,	Kikuyu.
	Thus, not *Mikindány*, but	Mikindáni.
	not *Kwaly*, but	Kwale.
z	English *z*	Zulu.
	Accents should not generally be used, but where there is a very decided emphatic syllable or stress, which affects the sound of the word, it should be marked by an *acute* accent.	Tongatábu, Galâpagos, Paláwan, Saráwak.

EXTRACTS REFERRING TO NOMENCLATURE OF GEOGRAPHICAL FEATURES, FROM ADMIRALTY GENERAL INSTRUCTIONS FOR HYDROGRAPHICAL SURVEYORS, 1888, p. 16.

"The surveyor should therefore take every pains to ascertain the acknowledged or native names. * * * Where such acknowledged names cannot be obtained, then let the surveyor freely give as many as will answer the purpose, but he should avoid the silly repetition of popular names, which so much tends to confuse our gazetteers and to perplex our memories. *He should beware of meddling with names already established;* these which have been stamped upon places by the first discoverer are held sacred by the common consent of all nations, and when new ones must be given it would show better taste to make the name convey some idea of the form or character or productions of the place, or some characteristic of its inhabitants, than to exhaust the catalogues of public characters or private friends. The officers and crews, indeed, may have some claim to such a distinction, which, slight as it is, help to excite additional interest in a laborious exploring voyage."

EXTRACT FROM LETTER OF PROFESSOR MACOUN, GEOLOGICAL SURVEY, DATED APRIL 12TH (INSTANT.)

"My work for the last four years has been an examination into "the geographical distribution of our vegetable productions, and "this has led me to use nearly all the geographical names in the "country. As time passed. I began to see the utter confusion "that existed in the spelling of the various geographical names, "and the evident misapprehension of the origin of many of them.

"Many places in Quebec and the Northwest have become half "English and half French, as River du Loup, River de Brig, and "even Cape d'Espoir, on the Bay of Chaleurs, has become Cape "Despair; you may imagine how foolish I looked when I said to a "gentleman as we passed along it on a calm day, that it was well "named Despair, for there would be no hope for any vessel forced "upon the cliffs. The answer was: 'You are wrong regarding "the name, as it means the Cape of Hope, not the Cape Despair, "as you seem to think.'

"In conversation with the French translators at the House, I "find they are troubled over this putting an English *dress* on a "French *form*, which there is no warrant for except our loose "habit of writing what we think, and ignoring authority.

"Taking this view of the matter, I would recommend that your "Committee press upon the Surveyor General the necessity of "adopting at once some uniform method of spelling the old "geographical names of every part of Canada, and would suggest "that he go back to the first authoritative map of the country for "the spelling. In doing this it would be very easy to make out "a complete Geographical Dictionary of the whole Dominion, and "we would have spelling and derivation in a most valuable form.

"Sooner or later, this will have to be done, and it is probable a "person could be found who would undertake the task for the love "of the work."

Very little need be added by the Committee to the remarks of the gentlemen submitted herewith, but for illustration and to show clearly the necessity for action in this matter, the following instances of erroneous naming of points and letter to the *Montreal Witness* may be of interest:

EXTRACT FROM A MEMORANDUM OF MR. R. H. HUNTER, DATED 6TH APRIL (INSTANT).

"St. Clements Point, Lake Winnipeg. On this point is situated "the small hut of a fur trader, named Jack Clements, a native of "Michigan; in consequence of his residence there during the past "few years, the point has become known to the frequenters of the "Lake as Clement's Point. Up to date, Mr. Clements has not "become canonized.

"Fort St. Frances, Rainy River District. This post of the "Hudson's Bay Company was named Fort Frances nearly sixty "years, in honor of Lady Frances Simpson, the wife of the Gov-"ernor of the H. B. Co. Although Lady Simpson was a devout "Christian and highly esteemed and beloved by all who had the "honor of her acquaintance, yet there is no record of her being "canonized.

"Lake St. Joseph, Albany River District. Although this Lake is "so named on the maps of the Department of the Interior and the "Department of Railways and Canals, the name is entirely un-"known to the residents of the district; it is known by them as "Lake Albany, and sometimes as the Big Lake Albany, in contra-"distinction to a small lake of the same name, some hundred miles "or so to the Northwest. It is true that the Lake has been known "to the French Canadian fur traders, or "coureurs de bois," as "Lac Joseph, but these traders never called it Lac St. Joseph.

"Blood River, east side of Lake Winnipeg. This should be "Bloodvein River, the former name being unknown to the resi-"dents of the vicinity. The name is given the river on account of "the red veins running or intermixed in the granite formation "through which the river runs.

"On some of the Government maps a portion of the Lake of "the Woods is improperly called Clear Water Lake, this name is "quite unknown to the residents and natives of that section; the "name has evidently been introduced by some surveyor or "draughtsman."

DUPLICATION OF NAMES, LETTER TO MONTREAL WITNESS.

"SIR,

"Your reference in a recent issue to the duplication of the names "of places raises a very important question. It seems to me that, "at least in the Northwest, the names of all important physical "features in the country, as rivers, mountains, lakes, bays, etc., "should be in the hands of the Surveyor General at Ottawa, so as "to avoid duplication. The matter, I understand, has been brought "before the attention of the Minister of the Interior, with a view of "having duplication remedied there before the country becomes "more settled, and before these duplicate names creep into hun-"dreds of deeds, books, reports, etc., when change will be exceed-"ingly difficult. Our own Northwest is not the model in respect "of duplication which you think it is. At present, we have four "Saskatchewan Rivers, including the North Branch, the South "Branch, the Little Saskatchewan at Minnedosa, and the Little "Saskatchewan, between Lakes Manitoba and Winnipeg. In the "works of Hooker, Richardson and others, it is often impossible "to ascertain whether the north or the south branch of the Sas-"katchewan is intended, and yet these two streams are 140 miles "apart. There are two large Red Deer Rivers, one flowing into "Lake Winnipegoosis, the other into the South Saskatchewan "There are two important Pembina Rivers, one in Manitoba, the "other near Edmonton, but a tributary of the River Athabaska. "There is a large Shoal Lake near Winnipeg and a smaller but "better known Shoal Lake near Birtle. Lakes and rivers named "after birds and other animals, as Swan, Heron, Pelican, Rat "Beaver, etc., are repeated in some cases several times. I have "never been able to see why the Indian names, where sufficiently "euphonious and appropriate, have not been retained. As the "surveys annually made by the Department of the Interior and "Geological Survey progress, new or little known lakes, rivers, etc., "are being constantly outlined, and, in such cases, there should be "no difficulty in giving appropriate names.

"In the older settled districts it is possible that an act of Parlia-"ment might be required to make changes.

A. T. D."

The subject is one which has no doubt received more or less attention from all persons engaged in any way in compiling maps or dealing with geographical names, and all must have noticed the many errors and inconsistencies that exist in our geographical nomenclature.

The Committee suggest the following scheme for adoption by the Government, to correct the many errors now existing and to prevent their re-occurrence:—

1. That some Officer of the Government be charged with the duty of collecting all the information necessary to enable him to compile a complete Geographical Dictionary of the Dominion, somewhat after the same style as that compiled for the Province of Quebec, by the late Surveyor General Bouchette of Quebec, published in 1832; and that all names as given by this Dictionary be officially confirmed, and the Dictionary thus become an authentic book of reference.

2. That it would be well that this Dictionary cover the whole Dominion, but if it be considered objectionable that the Department of Interior revise names at present existing in the older Provinces, then at least the maps of Manitoba, the Northwest Territories and British Columbia, and all sparsely settled districts generally should come under revision.

3. That special care should be taken to avoid duplication of names. Where several rivers, lakes or other natural features have the same name, and where the question of priority cannot be decided, the difficulty should be avoided by the use of synonyms in different languages—e.g., Red Deer, Elk, Wapiti, &c.; Saskatchewan Rapid, Rolling, Swift, &c.

4. That the Surveyor General, being in the opinion of the Committee the proper person, be charged with the duty of compiling this Dictionary.

5. That all names given by explorers in new tracts of country be submitted to the Surveyor General, and after approval by him be entered in the Geographical Dictionary before being shown on any maps or plans issued by the Government.

6. That the system of nomenclature and orthography suggested by Dr. Dawson, the Surveyor General, Captain Boulton and others as herein quoted, be followed as nearly as possible, and to further this end a memorandum of instructions should be issued by the Surveyor General for the guidance of all persons conducting explorations in new or unknown districts, and who may be called upon to give names to geographical features met with by them.

It may be pointed out that the only branches of the Government service that are engaged in conducting Geographical explorations in unknown portions of the Dominion are the survey branch of the Department of the Interior and the Geological Survey, both of which are under the control and direction of the Hon. the Minister of the Interior; and also that all the maps or plans of Manitoba, the Northwest Territories and parts of British Columbia are prepared under his direction, it would therefore, be possible for him to take such action as would give immediate effect in a large measure to the suggestions herein contained.

Signed on behalf of the Committee,

E. J. RAINBOTH,
President.

* * *

THE YUKON RIVER AND ITS SOURCES.

Fort Reliance, Pelly River, N.W.T., September 1st, 1887.

To the President and Members of the Dominion Land Surveyors Association.

Gentlemen,

Your worthy Secretary, before my departure from Ottawa last spring, insisted that I should write something for the next annual meeting of the Association. To my objection that I would not be in a position to do so, and, moreover, that I would have nothing to write about, he would not listen, but imperatively demanded a paper. With this statement as my excuse, I will inflict the following upon you:

You will not expect under the circumstances a professional paper, anyway you will not get one, so I will give you what might be called a geographical paper, which though not considered strictly appropriate for the pages of our annual report, may yet be of some service to some members of the Association in their rambles through this part of our Dominion. I will presume that you are all aware that I have been sent out to make an exploratory survey of the Lewes River and the Yukon from the Coast Range, at the head of the Lewes River, down to the 141st Meridian, west of Greenwich, or the International boundary line.

I began my operations at Pyramid Island, in Chilkat Inlet, a point, the geographical position of which was determined, in 1869, by a party of the United States Coast Survey. I carried the survey across to Chilkoot Inlet, thence to Taiya Inlet, and up the same to what was called by Schwatka, in 1883, the Perrier Pass, but it had already been named by the Karuse brothers the Dejäh Pass, or, as it is spelled by the United States Coast Survey, the Taiya Pass, to correspond with the name of the inlet which leads to it. A map showing the Chilkat and Chilkoot Inlets and their affluent streams, published in 1883, at Berlin, I think, shows the pass and calls it the Dejäh, as it also calls the inlet leading to it. Moreover, it gives the height of the summit of the pass as 1200 metres of about 3700 feet. My barometer readings on it, extending over three days, make it 4100 feet. About one mile of the pass on the south side is above the timber line, and on the north about six miles. The slope on the south side is much steeper than on the north, which accounts for most of the difference in the distances to timber line. It would be very difficult to even make a pack-trail, for the carrying of stuff by animals over this pass, owing to the steepness of its slopes near the summit and the depth of the snow, which covers it from October until August, and sometimes later. In June, when I was on it, there was as much as thirty feet of snow in some places. There is another pass just to the east of this one, which I have had examined by two of my party and reported on. I think this will be found the easiest inlet to this part of the country, should its requirements ever necessitate a resort to artificial means of improvement. It is somewhat larger than the Taiya Pass, but much lower. It is all timbered, which indicates, if we are to take the Taiya Pass as a criterion, that it is at least one thousand feet lower and probably more. There are no steep grades, consequently a railroad could be built through if required, I have called it the White Pass, after the Minister of the Interior.

There is tide water at one end of this pass and a lake at the other, which at once, without any further trouble, places us in navigable waters, by means of which we can freely move over a tract of three or four hundred miles, in which I feel confident large mineral deposits will yet be found. The waters I refer to are those of Tagish or Tahko Lake, Bennett Lake, Lake Marsh and the Lewes River down to the Cañon.

At the Cañon (Miles Cañon of Schwatka) the Lewes River narrows suddenly from two hundred yards to about thirty, with perpendicular walls of basaltic rock from sixty to eighty feet high. It is about five-eighths of a mile long, and when I saw it the current was about twelve and a half miles per hour. It is pretty rough for small boats, I might say dangerous; but large ones such as York boats, if kept from touching the sides on their way down, are safe. I ran through it with a boat thirty-one feet long, eight feet wide, and two feet deep, carrying about four tons and six men, and beyond taking a couple of barrels full of water, we met with no mishap. Our time through was a little over three minutes. Below the Cañon there are rapids for about a mile, but they are not very bad, we ran over them in our canoes with perfect safety. These are succeeded by good water for about half a mile, when we reach what is called by the miners the White Horse Rapids, from the fact that they are all white and very rough. They are about three-eighths of a mile long, the upper part about two hundred yards wide, and the last fifty or sixty yards, only about thirty wide, at which point the whole force of the rapids concentrates into one grand effort, so violent, that it confuses itself, and whirls, and eddies, and seethes back and forth at the bottom, as though desirous of making another rush over before leaving the exciting race for ever.

This rapid is pronounced dangerous by all who have seen it, and I concur in the opinion. Some have gone through it on rafts, which are much safer than boats, and one or two in boats, but they do not wish to repeat the trip.

The Cañon and these rapids are the only obstructions to navigation on the river, from the head of Bennett Lake to the mouth. Rink Rapids are nothing more than a ripple, caused by the waters of the river being dammed back by large masses of conglomerate rock standing in the channel. The river here has worn its way through a ridge of this formation, and left these masses standing. It is somewhat rough for small boats, but all run it loaded.

Of the branches of the river I will only speak of the Hootalinqua (Tes-lin-too), which from its appearance might be called the main stream and the others the branches. It joins the Lewes ninety-four miles below the Cañon. Schwatka called it the Newberry, but seemed to have given it no further attention, though it completely changes to its own the character of the river below the junction. From accounts I have got of it by Indians, it, or one of its branches, heads near the Taku Inlet; for they say it only takes four days, loaded, to pack from the head of canoe navigation on it to salt water on the Inlet, and about one day, light or unloaded. Miners who went up it this year told me it is a hundred and seventy-five miles, from its junction with the Lewes to a lake which the Indians call "Aukland Lake," an Indian name which means "the largest." Out of this lake they went up a river which they say heads near the Liard River. The lake they called a hundred and and fifty miles long, as it took four days to row a light boat from one end of it to the other, but I think these distances are imaginary to a large extent. The Indians say it takes them two days in fine weather to traverse it, and described it as being like Lake Labarge, which is only thirty-one and a half miles long, but I think they are at the other extreme. Perhaps some of you, gentlemen, may have the pleasure of determining the relative value of these statements. I would like to extend this article, but find I cannot now do it. I have written it very hurriedly and must quit it in a hurry, which I hope will incline your critical ears to leniency. Appended is a table of distances by the survey from Hames Mission on Chilkoot Inlet to Fort Reliance on the Yukon River.

Hames Mission to entrance of Taiya Inlet in miles	4.83
Head of Taiya Inlet	20.46
Head of Canoe navigation, Taiya River	26.46
Forks of Taiya River	28.78
Summit of Taiya Pass	35.47
“Landing” at Lake Lindeman	43.91
“ Foot of Lake Lindeman	48.41
Head of Lake Bennett	49.01
Boundary line B. C. and N. W. T (Lat. 60)	59.20
Foot of Lake Bennett	75.21
Foot of Caribou Crossing	77.88
Foot of Tagish Lake	94.91
Head of Marsh Lake	99.93
Foot of Marsh Lake	119.33
Head of Canon	145.48
Foot of Canon	146.10
Head of White Horse Rapids	147.85
Foot of White Horse Rapids	148.25
Takaheena River	162.75
Lake Labarge	176.12
Foot of Lake Labarge	207.80
Hootalinqua River (of miners, “Newberry” of Schwatka)	240.00
Big Salmon River (of miners “d'Abbadie” of Schwatka)	274.02
Little Salmon River (of miners “Daly” of Schwatka)	310.84
Rink Rapids	371.13
Pelly River	430.58
White River	528.03
Stewart River	538.00
Fort Reliance	612.53

The boundary is probably ninety to a hundred miles down the River beyond Fort Reliance.

WM. OGILVIE.

Discussion.

Dr. G. M. Dawson said that he had much pleasure in confirming the statements, made in Mr. Ogilvie's paper, on the Lewes River. He had met Mr. Ogilvie in August, at the mouth of the Lewes, and though both parties were, owing to unforeseen difficulties, about a month later than had been intended in reaching that place, they had been so fortunate as to arrive there within a day and a half of each other. He stated that Mr. Ogilvie deserved to be complimented on the energy which he had shown in overcoming difficulties on the portage, from the Taiya River to Lake Lindeman. He had a great amount of stuff to get over the portage, and the fact that he had taken his two Peterborough canoes across the mountains from the coast was in itself one worth recording.

While agreeing with Mr. Ogilvie as to the apparently larger size of the Tes-lin-too or Hootalinqua at its junction with the Lewes, he stated that when on the way up the latter river, he had cross-sectioned both streams near their confluence, and found that the Lewes actually carried a considerably greater volume of water. The Tes-lin-too was much wider than the Lewes, but it was comparatively shoal, and the current was not nearly so swift as in the Lewes. It did not follow, however, that the drainage basin of the last-named stream was larger or its sources more remote than those of the Tes-lin-too, as the Lewes was supplied from the perennial snows of the Coast Mountains, while the Tes-lin-too unwatered a relatively dry country in the interior. Dr. Dawson then made some remarks respecting the names of places in the Yukon district, and the unwarrantable liberty which Lieut. Schwatka had taken in applying entirely new names to features which were well known and had already been named by miners. He said that while the river, which he had just referred to as the *Tes-lin-too*, was marked on the United States Coast Survey map of Alaska and adjacent regions, as the *Nas-a-thane*, it was known to the miners as the *Hootalinqua*, while Schwatka, in 1883, had named it the *Newberry* or *Tes-el-héena*. Tes-lin-too is the name by which the river is known to the Indians of the locality. Hootalinqua is ineligible as having already been applied to another river in the same district, for which this appears to have been mistaken. Nas-a-thane and Tes-el-héena are inexplicable. It is, therefore, proposed to designate the river as the Tes-lin-too or Newberry.

The above remarks on Geographical Nomenclature brought forward Dr. Bell, the Vice-President, Prof. Macoun, and Commander Boulton, who, one and all, testified to the numerous conflictions and absurdities in geographical names that were to be met with in all parts of the Dominion.

Dr. Dawson thought that it was a matter the Association might well take in hand, and that if a committee on the subject were formed, a scheme might be suggested that would, to a great extent, remedy existing evils.

J. S. Dennis then brought in resolution No. 9, naming a committee to act in the matter, which was carried. Resolutions of thanks to Mr. Ogilvie for his interesting paper, and to the Assistant Directors of the Geological Survey, and Commander Boulton, for their valuable remarks thereon, closed the debate.

THE PLACING OF PERMANENT MARKS IN THE FIELD, AS A MEANS TO PRESERVE THE INFORMATION AFFORDED BY PUBLIC SURVEYS.

In venturing to put forward any views of mine before the Association of Dominion Land Surveyors, I take leave to premise that I am fully aware they may be of very little value. There is no doubt but that I am behind in the profesional science of the day, and I have seldom an opportunity of exchanging ideas with a professional friend. Nevertheless it is possible I may remind the Association of matters at present overlooked, that are worth attending to, and if such is the case, benefit will follow, if they receive the consideration they deserve.

Few will deny that it is a great mistake not to preserve every extensive survey, whether made for railroad, exploration, or other purpose, by permanent marks in the field as well as by their maps. When I first came to the County of Pontiac, some of the station marks and pickets of the Ship Canal Survey, by Mr. Walter Shanly, were standing on the banks of the River Ottawa. That survey is now obliterated. I am satisfie d that it would be impossible to restore it. I had occasion lately to use some of the maps, to get from them a more accurate trace of the front of one or two townships than can be got from the township plans, and I found the meridian laid down as much as fifteen degrees in error, in fact, but for a plan of part of the river by Capt. Deville, on which I need scarcely say the meridian was correct, I should have been put to some inconvenience.

Engineers seldom make use of a meridian line, so they take no trouble to lay it down correctly. This was, however, a very accurate and well executed work, and if preserved, so that the lines could be retraced, would be now of great service for checking previous surveys; for no country in which a survey was ever performed required means of checking former surveys more urgently than did that on the North shore of the Ottawa, between Aylmer and Fort Coulonge; and it seems inexplicable that the opportunity offered by Mr. Shanly's survey was not taken advantage of. When township outlines, represented on the original plan as straight lines, with concessions about a mile deep, deflect from the given course as much as thirty degrees on this side and on that, the interests of the settlers in the neighborhood call loudly for verification. Lest it be supposed that I am overstating the case, I give the notes of a township outline (reported course being due North and South) as taken from the verified plan. "(1) N. 9° W., 81 chs. (2) N. 4° E., 50 chs.; and N. 8° W., 25 chs. (3) N. 8° E., 111 chs. (4) North, 81 chains. (5) N. 15° W., 75 chs." Of course the country being heavily wooded at the time of the Ship Canal Survey, only a few points on the bank of the river could have been established,—true, but meadow and corn-field now cover vast tracts where twenty years ago the good green wood sheltered the bear and deer. Some short time since I had occasion to go to far back settlements, where I had not been for a length of time. I found it difficult to recognize the places I knew I must be passing through. Surely! thought I, that cannot be the Quyon River, or I would know where we are, yet it was; but the "where I am" of to-day is not like the "where I was" twenty years ago, when I was passing over the same ground on horseback. The surroundings are different. My horse, that should be tired, becomes restive and impatient; he is excited by four deer that intended to cross the road ahead of me, but the steed has communicated his excitement to the rider, and we score against the deer, a race won, they turn and run back now to cross, horse and rider turn also and score another victory. The deer cannot make time through the old timber works, one of them gets on a log and surveys the position, but he does not take long to decide that the time and place are unfavorable for a crossing, and then he retires with his companions to their native fastnesses. What a digression this, but may I not hope to be forgiven? How better describe the change that has taken place than to contrast the country, as I have seen it, with what it is to-day. The pine forest I was then in has past out of existence, there are not even stumps, where it was, to obstruct the plough. To "tie in" now with the point whence I made this wide departure, I shall observe that had some points been marked, and their position accurately determined by Mr. Shanly, survey lines could be run from them now, in some places, as easily as on prairie, by which other points might be fixed, and others again from these.

What kind of marks would best serve to render the survey permanent should be considered. I think I recollect having seen the marks of the Ordnance Survey in Ireland, cut on the walls of houses; a few such marks cut on rocks, and stone buildings, in the vicinity of a railroad survey, and noting the intersections of roads with its lines, should make it everlasting. It is unnecessary to say how other points, far asunder, could be connected by means of these, hill tops for instance, that might serve as the extremities of the base of a triangle, by which a still more distant point might be determined.

As in many of the operations of trigonometric surveying, the radius of curvature of the meridian, and that of the great circle perpendicular to it, are required, I may mention that there is a Table, No. II, in Loomis' Astronomy, No. III, in Chauvenet's, from which they can be found very easily with the aid of a short auxiliary table, which I computed, and as I have never seen or heard of one of the same kind, I submit it now with deference to the Association.

I am of opinion, too, that Cadastral Surveys should be made, so as to contribute, more than they do, to the geographical knowledge of the country. The width of every township that is cadastrated should be determined by a careful traverse, made with transit and steel band, to serve as a base of operations; this would entail very little additional expense, and as we have a Dominion Land Office, to make it better serve for the Dominion, let a copy of the plan and notes of every such traverse occupy a place in its archives, or rather of so much of them as would furnish data for future operations. In a Railroad Survey this would be a trace of the lines run with courses and distances, showing the points that had been permanently marked in the field.

In conclusion, then, I would suggest that steps be immediately taken to render the public surveys of the future permanent, by enduring field marks, and in furtherance of this object, that a competent land surveyor be employed on all such surveys, whose duty it shall be to determine the astronomical courses of the lines surveyed, and to leave permanent marks in the field (the position of which shall be accurately determined) in connection with these lines.

Finally, it should not be forgotten that "Geometer," though written in English characters, is a Greek word, and is the exact equivalent of "Land Measurer;" and that Geometry, the mother of the sciences, a very embodiment of truth, takes its name from Geometer; it is none too soon then to make an effort towards removing from the Professors of this most noble science the stigma of untruthfulness that attaches to their work, owing to the grotesque surveys of the old Colonial days.

S. L. BRABAZON.

TO FIND THE RADIUS OF CURVATURE OF THE MERIDIAN AND OF THE GREAT CIRCLE PERPENDICULAR TO IT.

Let ϕ == the geographical, ϕ' = the geocentric latitude, r == the geocentric radius, a = 1 = semiaxis major, ρ = meridian rad. of curvature, N = rad. of great circle perpendicular to meridian, R'' = radius in seconds.

By the common formulas

$$\rho = \frac{1 - e^2}{(1-e^2 \ \sin^2 \ \varphi)^{\frac{3}{2}}} \ (1) \quad N = \frac{1}{(1 - e^2 \ \sin^2 \ \phi)^{\frac{1}{2}}} \ (2) \quad r = \left(\frac{\rho}{1-e^2}\right)^{\frac{1}{3}} (3).$$

$$r == \left(\frac{\cos \phi}{\cos \varphi' \cos \ \phi \ - \ \varphi'}\right)^{\frac{1}{2}} \ (4)$$ from which can be

derived $$\rho = (1 - e^2) \left(\frac{\cos \phi'}{\cos \varphi \cos \varphi - \phi'}\right)^{\frac{3}{2}} \ (5)$$

$$== \left(\frac{(1 - e^2)^{\frac{1}{3}} \ \sec \ (\phi - \phi')}{r}\right)^3 (6)$$

To compare the different methods, find ρ and N for latitude 54°. 0' == ϕ.

$$\begin{array}{lll}
 & \phi \ \sin & 9{\cdot}9079576 \\
 & & 2 \\
\hline
 & & 9{\cdot}8159152 \\
 & e^2 & 7{\cdot}8244252 \\
\hline
\underline{0{\cdot}0043685} \quad e^2 \sin^2 \phi & & 7{\cdot}6403404 \\
\hline\hline
0{\cdot}9956315 == -e^2 \sin^2 \phi, & \log & 9{\cdot}9980986 \\
 & & 3 \\
\hline
 & & 2{,}9{\cdot}9942958 \\
\hline
(1 - e^2 \sin^2 \ \varphi)^{\frac{3}{2}} & & 9{\cdot}9971479 \\
\hline
ac & & 0{\cdot}0028521 \\
1 - e^2 & & 9{\cdot}9970916 \\
\hline
\dfrac{1 - e^2}{(1 - e^2 \sin^2 \varphi)}^{\frac{3}{2}} == \rho & \log & 9{\cdot}9999437
\end{array}$$

By Formula 2.

$$\begin{array}{lr}
1 - e^2 \sin^2 \phi \ \log & 9{\cdot}9980986 \\
\hline
(1 - e^2 \sin^2 \varphi)^{\frac{1}{2}} \cdot & 9{\cdot}9990493 \\
\hline
ac N & 0{\cdot}0009507
\end{array}$$

If a == equator rad. in feet

$\rho \times a$ == Rad. of cur. in feet

$\rho \times \frac{R''}{a}$ = Rad. of cur. in seconds

2ND METHOD.

From Auxiliary Table for $\phi - \phi' = 10' \ 57''$ == 9·9990327 or find N thus

r from Lomis Table XII. = 9·9990515

$$\begin{array}{lr}
\hline
\sqrt[3]{\rho} & 9{\cdot}9999812 \\
 & 3 \\
\hline
\rho == & 9{\cdot}9999436 \\
1 - e^2 & 9{\cdot}9970916 \\
\hline
 & 0{\cdot}0028520 \\
\hline
N & 0{\cdot}0009507
\end{array}
\qquad
\begin{array}{lr}
\sqrt[3]{\rho} & 9{\cdot}9999812 \\
\sqrt[3]{1 - e^2} & 9{\cdot}9990305 \\
\hline
N & 0{\cdot}0009507
\end{array}$$

By Formula 3. $$\left\{\left(\frac{\rho}{1-e^2}\right)^{\frac{1}{3}} ==\right.$$

$\phi - \phi'$ == 10′ 57″ is found in Loomis Table for latitude 54.° Opposite to the same $\phi - \phi'$ in the Auxiliary Table we find 9·9990327, the log. of $(1 - e^2)^{\frac{1}{3}} \sec (\phi - \phi')$ a factor in formula (6).

AUXILIARY TABLE TO BE USED WITH TABLE XII. IN LOOMIS ASTRONOMY FOR FINDING RADIUS OF CURVATURE.

From Loomis.		Capt. Clarke.		Loomis values
$\phi - \phi'$	$\sqrt[3]{(1-e^2)}\,sec(\phi-\phi')$		$e^2 = 0066746$	$\bar{3}$·8244251
2′ 00″	9·9990306		$1-e^2 = ·9933294$	$\bar{1}$·9970916
3 00	307		$(1-e^2)\frac{1}{3}$	$\bar{1}$·9990305
4 00	308		$R'' =$ arc $=$ rad. in seconds	5·3144251
			$a =$ equatorial rad. in feet	7·3206364
4 30	9·9990309		$\frac{R''}{a}$	7·9937887
5 00	310			
5 30	311		From Manual of Surveys	
6 00	9·9990312		$(1-e^2)$	$\bar{1}$·9970506
6 30	313		$(1-e^2)\frac{1}{3}$	$\bar{1}$·9990168
7 00	9·9990314		Equatorial rad. in feet	7·3206874
7 20	315			
7 40	316			
8 00	9·9990317			
8 20	318			
8 40	319			
9 00	9·9990320	9·9990183		
9 20	321	184		
9 40	322	185		
10 00	9·9990323	9·9990186		
10 15	324	187		
10 30	325	188		
10 45	326	189		
11 00	9·9990327	9·9990190		
11 15	327	191		
11 30	9·9990329	9·9990192		

Loomis gives in his Astronomy $\frac{b^2}{a^2} = 1 - e^2$ log. 9·9970916. From Clarke 's values of a and b in Manual of Surveys, p. 79, we get for $\frac{b^2}{a^2}$ log 9·9970506. In the third column, there is as much of the table computed from the latter elements as will cover the ground from Essex on Lake Erie to Hudson's Straits.

DISCUSSION.

J. S. DENNIS described the method of marking corners in Manitoba and the Northwest.

E. J. RAINBOTH described the method of marking corners in the Province of Quebec ; and G. B. ABREY described the method adopted in the Province of Ontario.

Finally Mr. Brabazon's paper was referred to a Standing Committee.

BRITISH GOVERNMENT SURVEYS.

In a geodetic sense these are the Hydrographical and the Ordnance Surveys, and I will first speak of the former, to which I belong.

The substance of the minute issued on the formation of the Hydrographic Department of the British Admirality, dates Aug. 12th, 1795, and runs as follows:—

"The great inconvenience (especially when ordered abroad) felt "by officers commanding His Majesty's ships respecting the navi- "gation, has led us to consider the best means for furnishing such "information, and preventing the difficulty and danger to which "His Majesty's ships must be exposed from defects on this head.

"On examination of charts in office, we find a mass of informa- "tion requiring digest, which might be utilized, but owing to the "want of an establishment for this duty, His Majesty's officers "are deprived of the advantages of this valuable information. We "therefore propose that a proper person be fixed upon to be "appointed Hydrographer to the Board, to be entrusted with the "care of such charts as are now in office, or may hereafter be "deposited, and to be charged with the duty of collecting and "compiling all information necessary for improving navigation, "for the guidance of the Commanders of His Majesty's ships. "The extent of such an establishment not to exceed the sum £650 "per annum, in aid of which £80 a year given to one of the clerks "of our secretary for his care of the charts above mentioned, and "£100 for care of the office papers will be applied so that the "actual expenses of the new establishment will not exceed £470 "per annum."

The proper person *fixed upon*, for Hydrographer to the Board, was a Mr. Dalrymple, not a naval officer, but a very remarkable man, who for the previous forty years had been employed in the East India Company Service, extending their trade, by means of his geographical, exploratory and nautical surveying work.

Mr. Dalrymple was an F.R.S., and ranked high among the scientific men of his day. He was strict to a degree towards those of his newly created Department, all of whom at that time received their pay weekly through him, and a portion of which was invariably stopped for absence, whether from sickness or any other cause; the only holiday he allowed was Xmas day. After thirteen years residence in London, Mr. Dalrymple's Department was re-organized, the main result of which was the pensioning of himself. When in a letter he complains to the Admirality for superannuating him at the early age of 75, he departs from the usual cut and dried official utterances, and in the language of one of the poets exclaims: "To be resigned if ills betide; patient if favors be denied and pleased with bounties given. This is truly wisdom's part. This is that incense of the heart, whose fragrance mounts to heaven."

Although excellent running surveys had been made by Cook, Vancouver and others, yet captain Matthew Flinders, R.N. (who did so much early work in Australia), may be said to have been the first naval surveyor employed abroad who started under the auspices of the Hydrographic Department, but record does not show that even *he* received any extra remuneration for his surveying services.

The business of the Admirality Surveying Service is to make charts of the coasts of Great Britain, and her dependencies, and also the shores of those countries and nations, the people of which cannot undertake that work themselves, for the benefit of British trade as well as the safe navigation of the war vessels *protecting* that trade.

At the present time the Surveying branch of Her Majesty's Navy consists of 52 naval officers afloat and a staff of eleven naval officers, besides civilian draughtsmen at the H. O. in London, at a cost of about £112,000. The Admirality Surveying Service is not conbined with the Ordnance Survey under one Bureau as is the case with the similar services in the United States; *but*, as the Ordnance Survey of Great Britain embraces the shore line as far as the high water mark, the latter and the topography at the back of it are always demanded from Southampton whenever a new Admiralty chart is made of any portion of the coast of the United Kingdom. In Admiralty surveys abroad whenever a side of a triangle can be obtained from a geodetic survey, it is always used in preference to the smaller bases measured in a hydrographical survey.

While employed at the Cape of Good Hope in 1867-70, for instance, we were able to take up bases whenever we required them from two triangulations, the one from Cape Town north-westward to the boundary of the colony measured by Sir Thomas McLean, the Cape Astronomer, to verify the arc of the meridian measured by the French astronomer La Caille. The triangulation, over the eastern portion of the Colony, was done under the auspices of the Ordnance Survey, for the purpose of connecting the towns, farms, etc., of that the most settled portion of the colony. Both these parties made a point of carrying their triangulations down to the prominent headlands on the sea coast, with the view to a future hydrographical survey.

An abstract of the work was published, describing the character and position of the large stone cairns they left, together with the angles and sides of the triangles, and the latitudes and longtitudes of the main points, so that future local land surveyors could tie on their work to them.

In Australia, too, as far back as 1860, a portion of the Colony of Victoria was triangulated, which proved a great assistance to the naval officer carrying on the survey of that coast and under whom I was serving as a youngster.

When we cannot fall back upon these carefully calculated sides for bases, we measure our own, from one to two thousand feet long by a standard chain, the operation not occupying more than a day.

From this base a triangulation is carried out over a coast 30 or 40 miles in extent as the crow flies, which is as much as a small party on an intricate coast, like that of Georgian Bay, could manage in one season.

The latitudes and longtitudes of the two extreme points are determined astronomically and are entirely independent of the triangulation.

The astronomical bearing and distance are then calculated between them, and from the latter the scale is deduced.

As hydrographical work is dependent entirely upon the fickle elements, fixed instruments are seldom used in our service for celestial observations. These require too long a detention in one place, and on a really fine day on the water one wants to be everywhere at once but especially on outlying shoals. We content ourselves with the sextant, and artificial horizon, using equal altitudes of the sun for time, for the purpose of longitude, and circummeridian altitudes of stars, about the same altitude north and south of the Zenith, for latitude, thus cutting out very nearly any eccentricity on the sextant and error in the tabulated refraction. Three or four hours stellar observations will give us the latitude, and the same time spent in observations of the sun by day, will furnish us with the longitude, to within 100 feet of distance, which error on the scale I am working, viz. : one inch to the nautical mile, is quite unappreciable on paper.

The principal instruments used in a hydrographical survey for detail are the theodolite, sextant, and station pointer. As the last is used only by *us*, an inspection at the close of this paper may be interesting.

The principle of its construction is based upon the 21st prop., 3rd book of Euclid, that the angles in the same segment of a circle, are equal to one another.

Two angles are taken by a sextant between a middle point and an object right and left of it: they are then laid off on the station pointer and the instrument moved about on the chart, until the bevelled edges of the legs cover the stations, between which the angles were taken, and the centre of the instrument corresponds to the intersection of the circumference of the two segments containing the observed angles. At the present time Admiralty Surveys are being carried on in China, East and West Indies, Mediterranean, Australia, both sides of Great Britain, and the St. Lawrence River below Quebec, as well as that in Georgian Bay.

Naval Surveyors together with Officers of the Indian Civil Service, have been employed for the last twenty years charting the coasts of India, at the expense and under the orders of, the Indian Government. A fair copy of the season's work is sent to the Hydrographer on the scale it is surveyed on. It is then taken in hand by the draughtsmen in the H. O., and redrawn for the engraver, on a slightly reduced scale. The object of reducing the scale being first for the purpose of supplying the navigator with as much coast on one chart as is compatible with intelligibility, the second to lessen or destroy any slight error which may have crept in in the detail.

It is arranged between the Hydrographer and the engraver (a private firm) what the price of the engraving is to be, and the latter proceeds to put it on the copper.

If he is not also a printer, the plate is transferred to a private printing firm. A dry proof is printed and sent to the H. O. for revision, after which as many copies are printed as the Admiralty chart agent may then require, the plate being kept by the printer in a fire-proof vault, to print future copies or to make corrections on.

The Admiralty chart agent, J. D. Potter, 31 Poultny, London, E.C., has the sole right of selling the Admiralty charts, and he appoints his sub-agents abroad.

The price of any chart is fixed by the Hydrographer and is printed on it, and at this price the chart can be purchased from Mr. J. D. Potter. *He* buys them of course from the Admiralty at a certain discount. The charts for Her Majesty's ships are kept corrected to date at the H. O., and supplied direct therefrom to them on their STARTING FOR a foreign station. I will now attempt to give you a brief account of the Ordnance Survey of Great Britain.

The survey is carried on in such a maner as to obtain the most accurate representation of the ground, and the details on it.

The position of well defined points, all over the country, such as tops of hills, church steeples, etc., at considerable distance apart, are ascertained with the utmost accuracy by a primary triangulation. The necessary observations consist in measuring the angle contained between all the points or "stations" that can be seen from the observing station, and are made by means of large and very accurate theodolites. The reduction of those observations is a lengthy and tedious operation.

A base line is measured with the greatest possible accuracy, and the lengths of the sides of every triangle calculated, and thus the position of every station is fixed. A secondary net work of triangles, based on the primary triangulation, is then formed, and when the survey is to be made on a large scale, such as 25 inches to one mile, a tertiary triangulation based on the secondary is needed.

The positions of numerous points, having been thus obtained, the detailed survey can be commenced, and is generally made by taking measurements with a chain. The great distinction between the above operations as carried on by the Ordnance Survey, and as performed by individual surveyors, is that all the operations are done on the Ordnance Survey, by different persons, who, therefore, form a check upon each other.

The first base line was measured by Major General Ray on Hounslow Heath in 1784; its object being to establish a triangulation for ascertaining the difference of longitude between the observatories at Greenwich and Paris. It was measured by Ramsden's steel chain, by deal, and also glass rods, with the following results:

By chain,	27404.55 feet.
deal rods,	27404.31
glass rods,	27404.08

In 1791, this base was again measured by a chain with a result of 27404.31 feet. Since that time four other bases have been measured in various parts of Great Britain. The bases selected for the primary triangulation of Great Britain were the Loch Foyle 7.89 miles in 1827-28, and that on Salisbury Plain of 6.93 miles in 1849, both measured by Colby's compensation bars.

The primary triangulation was commenced in 1784 and completed in 1858, including the reduction of the observations. The secondary and tertiary triangulations are now approaching completion.

The survey of Scotland is complete, the cultivated districts on 25, and the Highland portions on 6 inches to the mile. The Survey of Ireland is finished on the 6 inch scale, and the county of Dublin on 25 inches to the mile.

The Survey of England and Wales is nearly complete on the 25 inch scale.

In the primary triangulation, the longest side is 111 miles. The instruments used were two 3 feet theodolites made by Ramsden, and a two feet theodolite by Troughton and Simmes. The primary triangulation is broken up into a secondary triangulation, whose sides are about 5 miles in length, and this again into the tertiary or parish triangulation of about one to 1½ mile sides. The instruments used in the two latter are 12 and 7 inch theodolites.

Each triangle of the parish triangulation on the 25 inch scale is allotted to a surveyor, and he is supplied with data to enable him to recover the trigonometrical station, but the sides of the triangle are traced for him on the ground by an observer using a 5 in. Theodolite.

He proceeds to split up the triangle into a network of lines measured by the chain, and from which offsets are taken to various points in the roads, hedges, houses, &c. He also measures the sides of the triangle, but he is ignorant of the actual lengths by calculation.

A second person lays down the lines on the plan. He sees that the lengths of the main lines as measured agree with their lengths as calculated; if the discrepancy exceed a certain amount, the line is sent back to the surveyor to be measured, This second person also lays down the subsidiary lines, and if they will not plot within a certain limit of accuracy they are also returned to the surveyor to be remeasured.

A third person plots the detail on the plan.

A fourth person makes a tracing from the detail which is given to a fifth person, who examines the work on the ground and corrects any error. This person also collects the names and investigates the spelling. He enters the names in a book, giving three authorities for each.

A sixth person draws the fair plan.

A seventh person plan-examines (*i.e.* checks) the draughtsman's work.

An eighth computes the area of each enclosure on the plan. Formerly these areas were collected into parishes and published in parish area books. The area of each field, &c., is now however printed inside the field itself on the plan.

Lastly the M. S. plan is examined in a general manner on the ground by an officer.

The plan then goes to the Levelling Division to have the levels inserted.

The offices in which these operations are carried on are scattered over the country in positions convenient to the work. All the documents are then sent to Southampton where they undergo a thorough examination. Then independently of this final examination there are eight persons who form independent checks on each other. All errors which may be made in the survey of a triangle are strictly confined to that triangle, and have no tendency to spread into the adjoining work.

As soon as the MS. plan is complete in every respect it is sent to Southampton for reproduction on various scales :—10.56 feet to a mile ($\frac{1}{500}$) for maps of towns where population is over 4000, 25·344 inches to a mile ($\frac{1}{2500}$) for parish maps, 6 inches ($\frac{1}{10560}$) for county maps.

1 inch $\frac{1}{63360}$ for map of the country.

The reductions are now made by photography (the pentagraph being given up), they are transferred to zinc, and copies printed therefrom, the dual operation being known as Photozincography. The advantage of this process is threefold. 1st. The work is more accurate, any possibility of error in reduction being eliminated. 2nd. The operation is much quicker; a plan the engraving of which took 12 years can now be produced in 2 days. 3rd. There is a great saving of expense.

During the dark days of winter, photographic printing of all descriptions is most tedious, and with large printing surfaces liable to continual failures, through non contact in the pressure frame.

To surmount this difficulty the electric light has been introduced with great effect. For this purpose an arc light of about 8000 candle power (Crompton D. Lamp) has been fitted up, and the electric current required is obtained from the dynamo that supplies the electrolytic tanks with current for electrotyping. The exposure required is about three or four times that required with ordinary sunlight.

J. G. BOULTON,
Staff Commander R. N.

* * *

NATURAL HISTORY IN CONNECTION WITH THE TOPOGRAPHICAL SURVEY.

Natural History, of late years, has been given a prominent place among the multifarious studies in our schools and colleges, and as a consequence of this, the attention of the public is being directed to our local Natural History and to the wider field of our whole Dominion. As the students of the last twenty-five years take their places in the arena of public life, they show by their promotion of Natural History subjects that what was taught them in their youth is already bearing fruit.

Ten years since, when the Geological Survey changed its name by Act of Parliament to that of the Geological and Natural History Survey, no provision was made in a monetary sense to prosecute the work of the Natural History section of the Survey, but Dr. Selwyn at once issued orders to the leaders of the various exploring parties to collect specimens in all the localities visited. In a few years afterward I was appointed Botanist and Natural History collector, and at once began to devote myself to the work, but chiefly to Botany.

The results of the last five or six years are of great value to the country and to science generally. Our Herbarium has already attained immense proportions, and we have suites of plants from nearly every part of the Dominion, and almost all our native species are represented in the Museum. In this line amateur collectors can do us little good, because what we want is in most instances what they would not see.

Ornithology has come in for its share of attention, and the appointment of a taxidermist a few years since has given an impetus to the collecting of birds, so that at present we have a large and very valuable collection of the birds of the Dominion in the Museum and one that any people might be proud of. Owing to the migrating habits of birds, nearly all our land species can be obtained by resident collectors, but there is much valuable and needful information that can be obtained by the members of the Topographical Survey better than by any other means. And this leads me to ask why *should not they* collect specimens as well as the members of the Geological and Natural History Survey?

While I think it would be a needless waste of time to procure the skins of any but rare or obscure birds, I think it of the utmost importance that all unknown birds seen in any part of the North Western Territories should be shot and the wings, feet, and head taken and brought back to Ottawa. Either Mr. Whiteaves or myself could easily identify them; if the birds were shot between the middle of June and the middle of August, we would learn the nesting region of every species shot. All nests found should be taken, and notes made at the time of the materials used in their construction. The eggs can easily be preserved, and I will show how at the end of this paper. You will see thus that much can be done in ornithology, but not in the way generally supposed.

Mammals, especially the smaller ones, differ altogether in their habits from birds, and hence the difficulty of procuring skins and gaining a partial knowledge of their habits, distribution and species. In the Museum we have fine examples of nearly all the larger mammals; but in the rodents, such as mice, rats, squirrels and gophers, we are very deficient. Bats also, and moles and shrews of all kinds, should be procured. In this field much can be done by you, as many species are very local in their habits and restricted in their distribution, and what one party would get in one district would be almost entirely different from those procured in another. Of every small mammal seen, good examples should be skinned, and the skins preserved and dried in the sun. In this way they will keep perfectly for a long time, but may be packed and sent away at once by mail. See directions at the end of this paper.

Scarcely anything has been done in either collecting or studying our reptiles, such as turtles, frogs, toads, lizards, newets and snakes, and there is a wide field for good work in this section. During the summers of 1885–87, I collected all these that fell under my observation, and had no difficulty whatever in preserving them or carrying them when found. All that is necessary is a gallon of methylated proof spirits, and a few glass jars, such as household canned fruits are kept in. Place the jars in a box packed with saw dust, and have a cover which can be easily put on or taken off, and this box can go with your outfit anywhere. As the men go out to their labor let each carry a small tin box that has contained pepper or baking powder, and when he sees any frog, toad, lizard or snake let him box it, and on his return to camp let it be punctured a few times and dropped alive into the alcohol in the jars. When one jar is full another can be filled, and so on. Small mammals, such as shrews, mice, and even small striped squirrels can be preserved for a time in the same way. Should the results be turned over to me, I would soon have the specimens determined, as I am in communication with specialists in this department, and what I could not do myself I could get done.

I shall not take space to enter into details regarding the collecting of insects, and land and fresh water shells, but it is so easily done that it requires very little knowledge to do it. Shells can be collected in small bottles, pill-boxes, or tin boxes, and when camp is reached the larger ones should be boiled for a short time, but not long enough to make the animal too soft, and it can then be picked out with a pin. All from the same locality, when dry and clean, should be put in the same box and labelled with the date and locality. Clams require more boiling, and when cleaned should have the two valves wrapped around with shoe-thread to keep them close, as when the hinge stiffens the valves cannot be closed without breaking them.

Butterflies can be easily preserved by closing their wings, and placing them singly in small envelopes and afterwards into a paper box which might contain hundreds of them. Beetles are collected by having small bottles suitable for the vest pocket, in which there is a little sawdust satuated with alcohol. At night any captures made during the day can be placed in the store bottle kept in the camp.

I have left the fish until the last, not because they are the least important, but because after botany they are the most valuable to the country in both an economic and scientific sense. It is too true that we know scarcely anything about our fish, either economically or scientifically, and in this direction anything that can be done will be of use to the Country. There is not a man in the Dominion who seems to think it necessary to study the habits and food of our fishes, and I would just ask gentlemen interested in the matter whether they take in the full significance of the fishery question when they speak only of the fish of the north-eastern coast. Throughout the whole world there is no other nation that possesses such a wealth of food fishes as Canada, and perhaps in no other portion of the world is this wealth so little appreciated. We who explore our rivers and lakes, and sail along unfrequented coasts, know something of this wealth, but who will tell us of the fish of Hudson Bay, at the mouth of the Mackenzie, and along the shores of British Columbia? It is in this connection that much valuable service can be done by every member of your Survey. Specimens of fish can be preserved in the same way as reptiles.

In conclusion, I would urge upon you the necessity of asking the Department for the appointment of a person competent to collect all kinds of Natural History objects to be attached to every large expedition which may be fitted out for any purpose whatever in connection with the North and North-west. Had this been done when the expedition was sent to Hudson Bay, the meagre returns resulting from those expeditions would have been so enhanced, that the economic value of the information would have more than covered the outlay. In no case does either England or the United States allow a scientific expedition to be fitted out without one or more naturalists being appointed to accompany them. For years I have seen with pain the almost criminal neglect of Natural History subjects in all cases outside of our own survey, and even here we have been so cramped for funds, that I have been unable to have an assistant in my work during the whole year, and as a consequence I have been compelled to confine myself almost exclusively to botany and ornithology.

In the foregoing notes, I have tried to lay before you the status of Natural History at present in official circles, the lines in which you can assist us, and the hopes for the future. I will not detain you any longer, but hope you may use your influence both as individuals and as a body to have Natural History placed on a better footing than it is at present. It is not for me to formulate a plan, but were I requested to do so I could very easily do it and could show, how, at a very small expense, under a competent head, the whole Natural History work of the Dominion could be carried on as effectively as the Botanical section is at present.

JOHN MACOUN.

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BRIEF DIRECTIONS FOR PREPARING SKINS OF SMALL MAMMALS.

FOR THE MUSEUM OF DR. C. HART MERRIAM.

Skin all mammals as soon as possible after death.

Lay the animal on its back, and make an incision along the middle of the belly from just behind the fore legs nearly to the vent. Be careful not to stretch the skin while removing it, and exercise great caution in skinning around the eyes and lips, which parts are easily cut. Skin as far down on the feet as possible, but leave in all the bones of the legs. Remove the bone from the tail by pulling it between the fingers. Take out the skull, being careful not to cut or injure it in any way, and wash out the brains; number the skull with the same number that is attached to the skin, and dry it in the shade. Never put arsenic or salt on a skull, but use powdered borax if necessary to prevent the remaining flesh from decomposing. Remove all fat from the skin, and cut off any tags of flesh that may adhere to it.

In cleaning off blood or dirt that may have soiled the hair, an old tooth brush and a liberal supply of cornmeal will be found most serviceable.

Poison all parts of the skin with dry arsenic, or better still with a mixture of powdered arsenic and alum in the proportion of four parts arsenic to one part alum, being particular to put an extra supply in the feet and tail. Put a wire in the body, letting it extend to the tip of the tail, but be careful not to stretch the tail. Use annealed iron wire of as large size as will easily fit into the tip end of the tail. In rabbits, foxes, and wildcats put wires in the hind legs also.

Stuff the skin to its natural size with cotton or tow (never use wool, feathers, or other animal substances); sew it up along the belly and place it flat on a board to dry (belly down), with the fore legs extended in front and parallel to the body, and the hind legs and tail directed backward. Attach to each skin a label, bearing the same number that is marked on the skull. On this label should be stated the length of the animal (from the tip of the nose to the end of the tail, the spine being stretched for this purpose); also the sex, date of capture (name of month should always be written in full), locality, and name of collector.

All skins should be thoroughly dry before they are packed. They should be wrapped carefully in cotton and packed in small wooden boxes. Cigar boxes do very well for the smaller species but must be strengthened by a thin piece of board across each end. They can then be sent by mail.

DISCUSSION.

J. S. DENNIS remarked that he feared that unless the collecting of Natural History specimens were made a part of the duty of surveyors, very little would be done in that direction, as they would be unwilling to spare the time from their proper duties unless specially instructed.

JOHN MCAREE agreed with Mr. Dennis, and said that unless there was a natural love of the research the time would not be given without the instructions from the Department.

Prof. Macoun stated that he agreed with both these gentlemen, and further that he did not think surveyors should neglect their duty or make their men do so for this object, but still to bear in mind that if only one skin were collected that was rare, it was conferring a great benefit on the science. What he did mean was, that on any large party such as a Topographical party a specialist should be attached.

J. S. Dennis explained that he did not intend to say that it would be a waste of time, but that he did not think it would amount to anything unless it were an especial part of the duty.

Prof. Macoun replied that he *did* think it would be a waste of time for the surveyor to collect specimens, that what he wished to convey was that a specialist should be attached to the larger exploring parties.

Resolution No. 14 was then moved by Mr. Dennis, seconded by Mr. McAree, and *Carried.* (See Minutes, p. 26).

Professor Macoun, thanked the Association for passing the above resolution, and stated that any third year student, in any of the Universities, would be quite well enough posted to do the work, and would cost little or nothing as he would be glad of the trip.

Resolution No. 15 was then passed, tendering a cordial vote of thanks to Prof. Macoun for his instructive paper.

Commander Boulton said that like the surveyors, his work took up so much time that he had very little chance of making Natural History observations. One thing, however, had struck him very forcibly, and that was, that in a little while, judging by what he had seen and heard, the lakes would be fished out. He denounced the "pound net" as a very destructive method, on account of the small size of the mesh giving the smaller fish very little chance of escape.

Prof. Macoun corroborated Commander Boulton's statements saying that our fish were being destroyed very rapidly, and no one seemed to care. To him it was terrible. The fish, he said, would soon be gone, and we would have artificial means of propagation, and the result would be that when put into strange waters they would be like a bird reared in a cage and would not know where to hide and in consequence the poor little devils would be gobbled as soon as they had to look out for themselves, as they would be partly domesticated.

Resolution No. 16 was then moved by W. F. King, seconded by J. S. Dennis, and *Carried.* (See Minutes, p. 26).

Professor Macoun said that it had been suggested to him that he should send out a circular before the survey parties started for work, and this he would do.

T. D. Green thought that these circulars should be sent to the Surveyor General and his permission asked to have them inserted in the instruction to surveyors.

G. A. McMartin suggested that the circulars should be sent to all Surveyors, not only to Government parties.

E. J. Rainboth, endorsed Mr. McMartin's views.

Prof. Macoun stated that there were perhaps a dozen small animals that scientific men knew nothing at all about, and quoted a species of Marmot, of which they had a specimen at the Geological and Natural History Museum that had been obtained by a mere chance.

E. J. Rainboth thought the best plan would be to send a number of these circulars to the Secretary-Treasurer to distribute.

This closed the debate.

MAP MAKING.

As early as 1600 B.C., the ancients had some idea of map making, or illustrating on a plane surface the topography of the earth.

In the Turin Museum may be seen drawn on rolls of old Egyptian papyrus, works that have been recognized as a topographical map of the mining district of Nubia, shewing a road between two mountains leading to the mines. Another sheet shows the victorious return of Sethos from Asia; the Nile with its crocodiles; and Lake Tismah with fish in it.

There are many accounts of ancient wandering tribes having constructed guide maps on wooden tablets, showing routes, and the boundaries of sea and land with tolerable accuracy. Among early scientific work is recorded an observation for latitude by the arctic navigator Pytheas about 326 B.C., who made a voyage to the extreme north, for the purpose of determining the figure of the earth. A little later on Decaearchus of Messana, in Sicily, made an attempt at a projection, and drew parallels of latitude on his maps.

The next important step in the science of cartography is due to the famous astronomer and geographer Eratosthenes (276–196 B.C.). His was the first comprehensive geography based on the sphericity of the earth, and he made the first geodetic measurement for the purpose of determining the size of the earth.

To the ancient Babylonians, however, belongs the high distinction of having inaugurated map making as a science, and of placing it on a sound basis. It was they who first divided time and space, so as to admit of scientific measurement, as is the custom of to-day. They divided the Ecliptic into twelve signs and later on into three hundred and sixty degrees, with the circle to correspond, and in this the Babylonians greatly aided the means of determining geographical position. The Greeks also introduced this method, about 150 B.C., but little progress, however, was made in geography or map making, until Ptolemy's time—about three hundred years later on.

In Ptolemy's work we find for the first time the mathematical principle of the construction of maps, as well as of several projections of the sphere.

In detail the errors of Ptolemy are numerous, on account of defective information, and the want of astronomical observations. He, however, founded correct principles, and may be regarded as the father of cartography, and his teachings as the ideal for the guidance of the modern map maker.

From Ptolemy's time until the revival of letters in Europe, but little progress was made in the exact sciences, although commercial and military enterprise contributed somewhat to a better knowledge of the earth's surface, through rough sketches, without any pretensions to mathematical accuracy.

Astronomy and geography made little progress among the Romans and during the middle ages, consequently map making as a science fell back into what might be termed a second childhood.

The Greek Fathers continued to teach the doctrine of the sphericity of the earth, but as the knowledge of Greek died out in western Europe, correct principles gave place to fanatical teachings, wherein knowledge of geography was considered a matter of opinion only astronomy was fantastic folly, and a knowledge of distant countries was treated as learned lumber, and as this narrow conception of things on the whole was the dominant one, map making practically ceased to exist.

Isidore of Seville (A. D. 636) was the father and master of false geographical teachings, and under him the people went back to the Homeric idea of the earth being a disc surrounded by the sea.

Isidore declared that the earth had the appearance of a wheel, and consequently the name wheel maps has been given to all the maps of the earlier middle ages.

The Arabians, however, made somewhat better progress. With the aid of the works of Euclid, Archimedes, Aristotle, and Ptolemy translated into Arabic (813 to 833), they measured a degree of latitude, and determined geographic position according to the Ptolemic principle. The Arabian astronomers did not unfortunately make maps; travellers and topographers cared little about astronomy, and only made rough route maps without reference to degrees, declaring at last that mathematical division only brought confusion into geography. The Arabians made a fair beginning, but as the theoretical and practical did not blend we have as a consequence but one arabic map, on a projection which, though interesting from a historic point of view, is only an unsuccessful copy of Ptolemy.

The introduction of the mariner's compass, in Italy, during the 13th century, indicates a gratifying improvement in cartography after a long period of stagnation. The Chinese undoubtedly had the earliest and always an independent knowledge of the compass, which they divided into twenty-four parts commencing at the south. It is not improbable that they communicated their knowledge to the Arabs, and through the latter the compass was introduced into Europe; however this may be Travio Gioja of Amilfi, A.D. 1307, was, perhaps, the first European to make a mariner's compass and to teach seamen the use of that important instrument.

The Italians divided the compass into thirty-two parts or points of eleven and a quarter degrees each, they then constructed numerous maps, with the aid of this instrument, which took the name of compass maps, because they were covered with the figure of a compass.

Part of the coast and some of the islands of the Mediterranean were mapped in this way, and seamen were enabled to determine the proper course to take by the numerous radii of the compass shewn on the map.

A chart, the extensive work of Prince Henry the navigator (1394–1460), gave need for maps with latitude and longitude. It was he who first opened a road through the unexplored ocean; the pathways of the human race up to this time being by inland seas, lakes and land only. The prince was always, during his busy life, an ardent cartographer, and the finest specimen of medieval map making that has been preserved was prepared under his patronage in one of the convents of Venice.

In the 15th century we note a complete revolution in map making as a science, and Ptolemy's great work was again revived in western Europe.

The 17th and 18th centuries mark the most important era in the science of cartography, being the period of transition in which the most important discoveries in mathematics, physics and astronomy were made, and which completely revolutionized the blundering methods of earlier ages. Of chief moment was the invention of the telescope (1606); Galileo's discovery of Jupiter's moon's (1610); calculations for the determination of longitude (1616); the application of trigonometry to geodesy (1615); the French measurement of a degree; the mirror sextant (1731), and John Harrison's chronometer in 1767.

During this period, maps with many valuable corrections were made. Traditional errors having been expunged. Later on France and Germany took the lead in the extensive publication of handsomely engraved maps, followed in England shortly after by Dowat's atlas of the world, published at the cost of the Duke of Argyle.

Up to this time map publishing was a matter of private speculation, and to France belongs the credit of successfully carrying out the first geodetic and topographical survey and complete set of maps, at the cost of the State. Other European powers soon followed, and these later maps are distinguished for their clearness and accuracy of detail. From 1750 to 1850 attention was mainly directed to the accurate delineation of the horizontal surface of the earth, it was not until 1816 that the vertical configuration of the earth's surface was represented on maps by contour lines or curves of altitude. Great Britain has been very active in geodetic surveying and the production of topographical maps since 1855, the Ordinance maps being too well known to require comment.

The largest areas that have been accurately measured are Asiatic Russia, British India, and the United States of America. The admirable charts of the Coast Survey of the United States and the practical results of the International Boundary Commission Survey, ought to be convincing evidence to Canadian statesmen of the need for a comprehensive and connected survey of the whole Dominion.

Excellent work has already been done in the Canadian Northwest and correct maps prepared therefrom, and at present there appears to be no urgent need for the contour lines of that comparitively flat and as yet but thinly populated country. The case of the older and more densely peopled Provinces is, however, very different; defective maps made largely from compass surveys, and oftimes published and re-published by unauthorized Yankee cartographical pirates, County Atlas's, and Tunison's Map of Ontario for instance, which surveyors throughout the Dominion know to be compilations of flagrant errors, and for any degree of accurate information worse than useless.

The present discussion of a geodetic survey is well timed and in able hands, and no body of scientific men are better qualified to discuss this important subject than the members of this Association, whose special training eminently fits them to undertake such an important work.

Physical geography, surveying and cartography are kindred sciences and follow in natural sequence. Geography simply describes the earth as the dwelling place of the human race ; surveying adds the details of horizontal and vertical measurements, and cartography by graphic illustration gives to both representation on a plane surface. These kindred sciences are of the greatest practical importance in the civilization of the world, being as they are the embodiment and application to man of all scientific and statistical information relating to the surface of the globe. They are a safe and profitable guide to the merchant, a valuable aid to the exact sciences, and the great adjusters of all natural and artificial land marks.

J. H. BROWNLEE.

BRANDON, MAN., March 8, 1888.

* * *

THE MINING INDUSTRY OF THE PROVINCE OF BRITISH COLUMBIA—PAST AND PRESENT.

I had been asked during the past summer to write a paper for the Association on this subject, but hesitated about doing so for a time, and only definitely made up my mind towards the latter end of December. A few days after, I was called away on a survey, from which I only returned on February 3rd. I make these excuses because the subject is both interesting and important, and with such limited time at my disposal I fear I cannot do it justice. Be that as it may, I will do my best.

It is difficult to obtain reliable information, as little has been written on the subject, so I have to depend upon personal observation and what I can gather from miners, who have actually worked in the places to be mentioned later on. This of course is a good way to obtain information, but it is at the same time somewhat difficult and laborious, for such a vast fund of anecdote and information can be collected, some of which is not very reliable, for on this subject in particular most men are inclined to exaggerate a little; one, therefore, has to trim, condense, reduce to the proper dimensions, and present it in such a form that it will be interesting, reliable, and at the same time not too long. This has been my endeavor.

For convenience I shall divide into

1st. PLACER MINING.

2nd. VEIN MINING.

Under the former head I will first of all give a sort of condensed narrative of the various discoveries of gold throughout the province, with such statistics as I have been able to gather, and afterwards go into the methods of working and separating the gold from the sand and gravel in which it is found.

The first authentic discovery of gold in British Columbia was on Queen Charlotte's Island, by Indians, in the year 1851.

It was next discovered at Pend d'Oreille, by Colville men, in 1853 or 1854.

In the autumn of 1857, Indians discovered gold in the Fraser River near a place called *Necomimin*, they sent word during the winter to half-breed friends in Washington Territory, the news spread, and caused the Fraser River excitement of 1858, and it was the first place in British Columbia where gold was found in large and paying quantities. Many experienced miners from California and elsewhere flocked into the country, and found gold in the bars of the Fraser River, from the mouth of the Harrison River, as far up as the season of 1858 would allow them to go. Among these were Boston Bar, Cornish Bar, Maria's Bar, Alexandria Bar, Hill's Bar, and many others. Hill's Bar justbelow the town of Yale may be taken as an example of one of the best. Ned McGowan (who by the way is an historical character) took $33,000 out of this bar in three months, and this bar alone is said to have yielded over one million dollars.

It is also said that the present site of the town of Yale, with the flat opposite, would yield a large amount of gold if extensively worked by hydraulic power. These early prospectors had many difficulties and hardships to overcome, the country was rough, mountainous and comparatively unexplored, and travelling by land was hard and laborious work, the waters of the Fraser river were also swift and dangerous. Experienced boatmen, however, ascended the stream ; among these were Ned Gallagher and Bill Lane, both of whom are well known characters.

In the year 1859 prospectors arrived at the mouth of *Quesnelle River*, which was found to be rich, and this stopped the onward march for a time.

In the summer of 1860, Keithley Creek, which runs into Cariboo Lake, was discovered, and this marks an era of renewed activity in mining, for it was the first of the many famous streams discovered in the famous Cariboo district, which is said to have been one of the richest placer mining centres ever discovered.

In the winter of 1860–61, miners went over a bold mountain, and discovered gold in Antler Creek by digging through the snow ; they kept it a secret, went down to Victoria, and tried to get a grant or lease of the stream from Governor Douglas, which was refused. The news became known and caused the rush to Cariboo. During the same year (1861), Grouse Creek, Williams Creek, Lightning Creek, Lowbee Creek, and Jack of Clubs Creeks were discovered. Five of these famous Creeks, namely, Williams, Grouse, Antler, Lightning, and Jack of Clubs Creeks head close to one another in a bold mountain.

Of these, Williams Creek and Lightning Creek were the richest.

Williams Creek was discovered by William Deitz, better known as Dutch Bill, and was named after him. He took up his claim in the cañon, supposing that all the gold would pass through there, and that it would naturally yield well. The ground, however, was shallow, and the run of gold was through an old back channel behind the canon, and his claim did not pay very well. Other miners, Barker who gave his name to Barkerville, among them soon after also located ground. At first they worked down to a hard blue gravel or cement, which was supposed to be bed rock, they obtained comparatively little gold and the creek was at first called *Humbug Creek.*

Abbott & Co., however, to test the creek, sank a *sump* hole 4 ft. x 7ft. through this, and took out 57 ounces of gold, and the other companies soon followed their example. Black Jack and others took up ground in the old channel behind the cañon, and Barker & Co., below the cañon, they struck it rich, and Barkerville was started. Later on Cameron & Co. located deep ground about ½ mile below Barkerville, it also proved to be rich, and Cameron town was started. Previous to this the town of Richfield had been built above the cañon near the head of the Steele claim, all three towns being within 3½ miles of the creek. Starting at the upper end, and going down stream some of the principal claims were as follows:

Steele & Co., or California Co.
Point Claim.
Abbott & Co.
12 foot Davis.
Adams & Wilson.
Casto & Co.
Dutch Bill.
Diller & Co.
Canadian Co.
Welsh Co.
Wake-up-Jake Co.
Cariboo Co.
Aurora Co.
Lillooet Co.
Forest Rose.
Cameron & Co.
Tinker Co.
Raby & Co.
Caledonia Co.
Grizzlie Co.
Never Sweat Co.
Ballarat Co.
Prince of Wales.
Sheep's Head Co.
Coonskin Co.
&c., &c.

This Creek is said to have been remarkably rich, and it must indeed have been so as may be seen from the following examples.

The largest amount of gold taken out in any one day's work on Williams Creek, or indeed, in Cariboo, was on Diller & Co.'s claims, it weighed 102 lbs., during the following day he took out 100 lbs., and this with only two men drifting. Diller is said to have taken out $100,000. Nearly two miles of Creek is said to have averaged over $1,000 to the foot of pay dirt. Cariboo Cameron took out $160,000. In the Aurora claim one pan of dirt yielded 587 ounces of gold. In the Adams claim one day's work gave 480 ounces, and gold to the value of 300 ounces per day was not uncommon. On Steele & Co.'s claims 100 feet of ground yielded $100,000 in dividends. The Point claim yielded in dividends $90,000. One hundred feet of the Wattie claim paid $85,000 in dividends. The 12 foot Davis claim, a gore between two other claims, paid in dividends $25,000.

The above examples of the yields in the different claims are the dividends actually paid, and do not by any means represent the actual yield which was much greater. As examples of the additional amounts expended for working expenses, I have been told that the pay roll on Raby & Co.'s claims for two weeks amounted to $12,000. Mr. Heron, the discoverer of the famous Heron lead on Grouse Creek, also informs me that their pay roll amounted to from $1,200 to $2,200 per week. This company took out $300,000, and for a time made from 100 to 250 ounces of gold per day.

Mr. Beatty, now well known as a successful shipping and business man, who is manager of the Canadian Pacific Railway Company's steamers on Lake Superior, and former owner of the Beatty line on the same lake, was one of the fortunate miners who made a strike at Cariboo, and so I might go on giving instances without number. I need only say that unless the claims yielded from $10,000 to $50,000 dividends to the interest of 100 feet, it was considered that they did not amount to much.

Lightning Creek ranks next to Williams Creek. I give below the names of some of the companies, with a rough estimate of their yields, including the working expenses :

Van Winkle Co	$600,000
Victoria Co	600,000
Vancouver Co	200,000
Point Claim	180,000
South Wales Co	200,000
Lightning Co	220,000
Butcher Bench	250,000
Dunbar Flat	150,000

Many other creeks yielding large amounts of gold were also worked, among these were Grouse, Antler, Lowbee, Jack of Clubs Harvey's, Snowshoe, Mosquito, Chisholm, Davis, Last Chance, Van Winkle, &c., besides numerous gulches and ravines.

The distance from New Westminster to Cariboo by the old route was about 520 miles. Miners went by way of Harrison River to Lillooet principally by water, through a series of lakes and rivers with portages between them. Lillooet was the headquarters for pack trains to Cariboo. During the great rush, the pack trains were inadequate to accommodate the great numbers of miners going into Cariboo, and they, therefore, had to resort to all kinds of devices, some packed on their backs, others with dogs, and still others with oxen. Ned Cannel who is well and favorably known at Kamloops bought an ox at Lillooet, trained him to pack, and this was the first pack animal to go into Williams Creek, where he was killed dressing 900 lbs. and sold for 60 cts. per lb.

Supplies, provisions, and wages were high, as might be expected, and as will be seen by the following list which may be taken as an example of the highest prices paid at any time, for they were of course much cheaper afterwards :

Flour	$1.50	per lb.
Bacon	1.50	"
Tea and Coffee	3.00	"
Sugar	1.50	"
Beef	0.60	"
Beans	0.75	"
Nails	0.75	"
Gum Boots	$30, $50	per pair.
1 spool thread	$0.50	
1 needle	0.50 to $1	
1 clay pipe	0.50	

Wages per man per day $10 to $16.

Exorbitant freight rates were the cause. "It is not the cost of the goods," said a trader to a miner, when selling him a darning needle for a dollar, "it's not the first cost of the goods it's the freight, mine friend."

The wagon road to Cariboo was finished in 1864, and the telegraph line bought by the Provincial Government about the same time. This telegraph line is famous, for it formed part of the line built by the Western Union Telegraph Company, which was to have crossed at Behrings Straits, and which was rendered useless by the successful laying of the Atlantic Cable.

Many places of less importance than Cariboo, but which, nevertheless, yielded a larger amount of gold, were discovered about this time.

Big Bend was discovered in 1864, by French Canadians from Colville, who went up the Columbia River in boats to French Creek.

The Principal Creeks were:

French Creek,
McCullock's Creek,
Gold Creek.
Downie Creek,
Carnes Creek,

and many of the bars on the Columbia River.

These streams paid well for about three years.

Kootenay, discovered in 1864.

Yield from 1864 to 1885, about $500,000. Some of the creeks were as follows: Wild Horse Creek, Bull River, Moyea River, Palmer's Bar, Weaver Creek, Dutch Creek and Findlay Creek.

Ominica River. This is a branch of Peace River, and was discovered in 1868. It yielded a large amount of gold, and 2000 men are said to have been working there during the excitement. This district is rich in quartz leads, but it is too far away from railroads at present to do anything with them. Vitalle Creek, Germanson Creek, Manson Creek, Lost Creek, Quartz Creek, and Silver Creeks, were some of the principal creeks.

Rock Creek, and *Similkimeen*, discovered in 1860, worked for a time paying well and then abandoned for Cariboo.

Cherry Creek discovered in 1863.

Tranquille Creek discovered in 1860.

Scotch Creek discovered in 1866.

Stikeen River discovered in 1863, worked for a time and then abandoned.

Besides these there were Louis Creek, Jamieson Creek, and in fact nearly all the creeks running into the Thompson River in the vicinity of Kamloops paid more or less.

Cassiar ranks next to Cariboo in importance. It was discovered in 1873, by Thibert, a French Canadian, and McCulloch, a Scotchman, who came from the Red River County, crossed the mountains and came up the Liard River. During 1873–4 over 4,000 men are said to have worked at *Cassiar*.

The principal creeks were:

Dease Creek,
Thibuts Creek,
McDame's Creek,
Walker's Creek,
Snow Creek,
Quartz Creek,
1st North Fork of McDame's Creek.

All of these creeks paid well for about three years, and were then left to the Chinamen and few remaining whites.

Miners went to Cassiar by ocean steamer from Victoria to Fort

Wrangle, by river steamer from Wrangle to Glenora Landing, 150 miles up the Stikeen River, then across an 80 mile portage to ***Dease Lake*** where there was another steamer.

The great Cañon of the Stikeen above Glenora Landing is a remarkable sight, it is 90 miles long, has high precipitous banks, from the description, probably basalt overlying gravel and cement, and is said to be truly picturesque. Good oats, barley, hay, and vegetables can be raised at Glenora Landing.

Snowfall and climate about the same as in Manitoba.

A road or trail was cut from *Quesnelle Mouth* to Dease Lake, a distance of about 425 miles.

During the first year freight and provisions were very high, freight across the 80 mile portage was 50c. per pound, and poor pack horses cost $250 each.

I have stated before that it is hard to obtain reliable mining statistics,—many reasons may be assigned for this. It must be remembered that before the gold excitement British Columbia was thinly populated and comparatively unknown, and up to that time it had been ruled by the Hudson Bay Co. Victoria itself was small, and when during the excitement many thousands flocked into the country, it necessarily for a time caused some confusion. Besides this there was not sufficient coin in the country to pay for the vast amount of gold brought down by successful miners, many of whom went on to San Francisco to dispose of their wealth, no account could be kept of this ; and, moreover, California, not British Columbia, was credited with having produced such gold. Very little information could be obtained from the Chinese miners, who are naturally secretive, and seem to decline for the mere pleasure of doing so. From these causes then it was impossible to obtain actual statistics, and numerous estimates of the yield of gold have been made, many of which are extravagant. Of these the one made by the government is the fairest and most reliable. According to it the yield in gold from 1858 to 1885 was nearly fifty millions of dollars. This represents about 2,986,270 ounces or 248,856 lbs. of gold, or it may be represented by a solid pyramid over 18 feet high, with a square base whose sides are a little over 6 feet. Of this amount Cariboo is credited with having produced thirty millions of dollars, or considerably over one half. As an instance of how successful miners were in general at Cariboo, it may be stated that in the spring of 1861, 1,200 miners crossed Beny and Adelers bridge over the Quesnelle, on their way into Cariboo, of these some 19 soon returned discouraged, the remainder returned in the fall bringing down altogether $1,500,000 worth of dust for their season's work.

I give a tabular statement from the sessional papers of 1886, shewing the yield in each year from 1857 to 1886. You may imagine, perhaps, that placer mining in this province has ceased, in doing so you would be making a great mistake, it has certainly fallen off very much from the yields in the palmy days, but this statement shews that the province still produces annually nearly $800,000 worth of gold. Many of the places which in the olden days were scenes of great mining activity have since, are now, and will yet be worked for many a year before they are exhausted, and worked extensively and scientifically too, for mining is a progressive industry, and with improved machinery, good roads, and lower freights and wages, the miner can still obtain a fair return for his labor.

And now, before closing this part of the paper, I would like to say a few words about the indirect benefit which British Columbia as a province has derived from the discovery of gold.

The history of most countries where gold in the form of placer deposits has been the first attraction has, so to speak, been intermittent, it has its periods of great activity when all have their golden dreams, and corresponding periods of depression when these have not been realized. The trade and commerce are increased for a time, it is true, and many thousands flock into the country only to leave it again, for the prosperity is only transient.

After a time, however, this ceases, the energy and perseverance of the population are turned into new channels, and new industries spring up. So it has been with British Columbia ; the discovery of gold laid the foundation of an era of permanent growth and prosperity which will be added to as years roll by. All honor then to the early prospectors and miners to whom the country owes so much, they brought with them health, strength, pluck, and a perseverance which surmounted all difficulties, and had a useful career as pioneers in the wilds of British Columbia.

TABLE.

Shewing the actually known and estimated yield of gold; the number of miners employed; and their average earnings per man, per year, from 1858 to 1885.

Year.	Amount actually known to have been exported by banks. &c.	Add ⅓ more, estimate of gold carried away in private hands.	Total.	Number of miners employed.	Average yearly earnings per man.
1858	$ 390,265	$ 130,088	$ 520,353	3,000	$ 173
1859	1,211,304	403,768	1,615,072	4,000	403
1860	1,671,410	557,113	2,228,543	4,400	506
1861	1,999,589	666,529	2,666,118	4,200	634
1862 } 1863 }	3,184,700	1,061,566	4,246,266	4,100	517
				4,400	482
1864	2,801,888	933,962	3,735,850	4,400	849
1865	2,618,404	872,801	3,491,205	4,294	813
1866	1,996,580	665,526	2,662,106	2,982	893
1867	1,860,651	620,217	2,480,868	3,044	814
1868	1,779,729	593,243	2,372,972	2,390	992
1869	1,331,234	443,744	1,774,978	2,369	749
1870	1,002,717	334,239	1,336,956	2,348	569
1871	1,349,580	449,860	1.799,440	2,450	734
1872	1,208,229	402,743	1,610,972	2,400	671
1873	979,312	326,437	1,305,749	2,300	567
1874	1,383,464	461,154	1,844,618	2,868	643
1875	1,856,178	618,726	2,474,904	2,024	1,222
1876	1,339,986	446,662	1,786,648	2,282	783
1877	1,206,136	402,045	1,608,182	1,960	820
1878	1,062,670	⅕ 212,534	1,275,204	1,883	677
1879	1,075,049	" 215,009	1,290,058	2,124	607
1880	844,856	" 168,971	1,013,827	1,955	518
1881	872,281	" 174,456	1,046,734	1,898	551
1882	795,071	" 159,014	954,085	1,738	548
1883	661,877	" 132,375	794,252	1,965	404
1884	613,304	" 122,861	736,165	1,858	396
1885	594,781	" 118,956	713,738	2,902	246
			$49,385,866		

METHODS OF WORKING PLACER MINES.

Before going into the methods of working placer mines, it may not be out of place to say a few words about the occurrence of gold in the sand or gravel.

The commonly accepted theory is the destruction of pre-existing vein matter. Another theory is that through the agency of organic acids and alkalies, the gold is brought into a state of solution, and reprecipitated in other localities by organic matter, in the form of nuggets. Thus gold, though soluble only to a small extent, may in a geological sense be largely distributed in this way. But it is hardly within the scope of this paper to account for the origin of the gold, it is sufficient to say that the auriferous gravel—or pay dirt, as it is called,—is found in localities where it has been deposited in a sufficiently concentrated form (to repay working) by the following agencies, *i.e.* :—

(1) The present system of water courses.

(2) Older systems following the same general direction, and in some places coinciding with the present system.

(3) Still more ancient water courses nearly at right angles to the modern streams.

(4) By the action of glaciers.

By one or by all of these agencies combined, then the gold has been distributed, but particularly so I think in this country by the action of glaciers.

According to my idea, the presence of gold in the so-called Gold Range of British Columbia owes its origin to this course, that it formed the channel so to speak of one of these immense flows of ice, carrying the auriferous *detictus* from its source in higher latitudes, and then as the ice melted it was deposited with varying richness in the localities where it has since been found. Probably also this has been further assisted, both directly by the ancient streams before the Glacial Period, and indirectly by the modern ones since. At all events then the gold has been deposited under various circumstances, and at various levels, in the old channels, in the modern streams, on benches, in gulches and ravines, and in some places almost at the summits of the mountains, often only a few feet below the surface, in other cases buried under hundreds of feet of barren soil or emptive rock, and the objective point of the placer miner is to extract this gold. Being found then under so many varying circumstances, it is impossible to lay down cast iron rules for mining, for what would suit in one locality might not work in another. The general principals are however the same, and I will now proceed to give a short account of how the miner accomplishes his end.

Placer mining may be divided into

Shallow Placers.

Deep Placers.

Shallow placers may be divided into wet and dry diggings, being the shallow beds of permanent streams, and dry gulches and ravines carrying water only during part of the year, and where bed rock is not more than say 12 feet deep. Mining in such localities is comparatively easy.

In *deep placers*, on the other hand, the pay dirt is often deeply buried in the soil, and it is sometimes at a considerable distance from water. The miner therefore labors under many difficulties, which necessitates the use of expensive, complicated, and ingenious machinery. It may be divided into

Hydraulic Mining.

Deep placer mining by hand.

The first requisite in mining is a plentiful supply of water, and if not on the ground it must be brought there by ditches and flumes.

The principal tools and appliances are as follows :—Picks, shovels, axes, drills, crowbars, hammers, miner's pan, cradle, derrick, pumps, water wheel, wheel barrow, sluice boxes, small car, hoisting bucket, rope, nails, crescent saw, whip saw, wing dam, etc. These are all brought into service in mining in one form or another, though in any one individual case they may not all be employed. The *crowbar* is used for removing boulders and other heavy objects. If the boulders are too heavy they may be reduced in size by blasting or with hammers, or they may be removed directly with a *derrick.*

The *miner's pan* is a very useful little instrument, it is made of pierced sheet iron, is circular in form, about 14 inches diameter on the bottom, 17-18 inches diameter on the top, and 5 inches deep. It is used for separating the gold from the gravel, by a sort of circular motion in water, by which the lighter sand and gravel drops over the lower edge, while the black and gold remains behind. The black magnetic sand is then removed with a blowing pan and magnet. The pan is also used for cleaning concentrates from the cradle, or for washing gold amalgam where mercury is used. It is especially useful as a prospecting tool.

The *cradle* is of more importance as a prospecting tool, but I give a description of it. It is a wooden box about 40 inches long, 20 inches wide, and 15 to 24 inches deep. It is mounted on rockers like an ordinary cradle, has a couple of cross pieces called riffles on the inside of the bottom to save the gold, and is slightly inclined, say, 2 to 4 inches. At the upper end on the top is the hopper, about 20 inches square, into which the gravel is thrown, the bottom of the hopper is perforated to allow the sand and gravel to pass through, this falls upon the *apron* usually made of blanket, the nap of which catches some of the gold while the riffles catch the remainder. The lower end is left open so as to allow the tailings to run away. The dirt is shovelled into the hopper, the water is added with one hand while the rocking motion is given with the other.

Sometimes where there is much stiff clay, a *puddling box* is used. It is simply a box which may be of any size, has an auger hole 4 to 6 inches from the bottom. This hole is plugged up, the clay added, and it is then thoroughly puddled with water. The latter is now run off, leaving the sand and gold in the bottom of the box, and the gold is separated with the pan.

The sluice is formed from a series of boxes made from planks 12 feet long and 1 to 2 inches thick, it is 16 to 20 inches wide and 10 to 12 inches deep for ordinary placer claims, and larger for more extensive workings. These boxes fit one into another, the whole is then supported on trestles, and set at an inclination of from 3 to 10 inches per box of 12 feet, depending upon the character of the gravel, and the available grade which the ground will allow. The boxes are provided with riffles of various form to catch the gold. The gold in this country is generally coarse, and not very much quick silver is employed, when the latter is in use amalgamated copper plates are often set.

The *Wing Dam* is a dam to turn the water from the claim. It is started at the head of the claim on either bank, runs in a slanting direction across the stream till about ½ the width of the creek is taken in, it then runs straight down stream for the remaining distance. The whole is weighted with heavy stones to prevent it being carried away, and is filled in with soil and gravel to make it water-tight. The space within the dam is then worked, and the dam is finally changed over to the other side of the stream which is worked in the same way. The *water wheel* is used for hoisting and pumping purposes. In shallow places when used for the latter purpose, it is an undershot wheel which projects over the side of the dam into the water, and runs the pump which is attached on the inner side of the dam.

To work a shallow placer in the bed of a stream then, the wing dam is first built, the sluices are then set up, as is the water wheel and pump when the latter is required. If an open drainage ditch can be built, the wheel and pump are unnecessary. The water is then turned into the sluice and the dirt and gravel shovelled in, the latter is carried away by the water, while the gold, from its superior specific gravity, sinks to the bottom and is caught by the riffles. The sluices are cleaned at intervals to obtain the gold.

In *shallow dry digging* the process is almost precisely the same, excepting that a wing dam is unnecessary, and water must be carried to the claim by ditches and flumes.

Deep Placers are the beds of permanent streams other than above, the benches adjoining them, and the channels of the more ancient streams, which are generally very rich. It can easily be seen that this description of mining must be very much more difficult than the working of the shallow placer.

I will first take up *Hydraulic Mining*, which may be defined as being that process of extracting gold from auriferous gravel, by means of water under great pressure, discharged through pipes and nozzles against the bank. It is absolutely essential that there should be:

(1) A plentiful supply of water under great pressure.

(2) Good facilities for grade and dump, by which the immense amount of tailings may be carried away.

As a general thing the richest deposit of gold is found immediately above and penetrating for a short distance into the slate forming the bed rock of the stream. A vast amount of barren soil therefore has often to be removed to get at the pay dirt; this can be done more economically by water than by any other means, and it is on this account that water is so largely employed by the miner as an aid, by means of which the gold may be extracted with profit to himself. The miner, having found a deposit of gold, has to explore it by means of shafts,drifts, &c., so that he may learn: 1st. The depth of the bed rock. 2nd. The width of the channel and extent of the deposit. He also has to ascertain how and where he may obtain a supply of water with a good working head. His next step is to choose the nearest available grade which can be given to the tunnel and the disposal of the tailings from the mine. The tunnel is then started and run to the desired spot below the deposit, being securely timbered throughout. The size depends upon the requirements of the work, and also upon whether the line of sluices is to be single or double, and it may vary in width from 5 to 10 feet, with a height of 7 to 8 feet. The tunnel, having been run well into the deposit or channel, has to be connected with the surface by means of a shaft, which should as a rule be vertical though inclines are also used. The direct connection of the shaft and tunnel is a work requiring great care and caution, for it is often dangerous from caves and rushes of sand, gravel and water. The line of sluices must also be laid and securely fastened, and they must be strongly built to withstand the wear and tear consequent upon running such immense quantities of boulders and gravel through them. They are furnished with riffles of various descriptions made of wood, stone, or iron. Blocks of wood, 8 to 10 inches deep, make excellent riffles, they are firmly arranged in position on the bottom, with suitable spaces of from 1 to 2 inches between them. Round stones are used in the same way, and are durable and cheap. Longitudinal riffles covered with bands of iron to prevent wear are also used, but whatever the form of riffle may be the object is the same, namely, to catch the gold and amalgam, for mercury is generally used in Hydraulic Mining. It is usual also to build a side lining for the sluice. *Grizzlies* and *undercurrents* are built at intervals. A *grizzlie* is put in a place where a drop can be given to a line of sluices, a grating of iron bars is set which carries the large boulders away, and allows the smaller material to drop through, disintegrating the clay and freeing the gold. *Undercurrents* are sluices of 15 to 20 feet wide, and 30 to 50 feet long, set at a very slight grade, and provided with riffles to catch the gold and amalgam, the sluice discharges into the undercurrent at the top, and again takes up the flow at the bottom. Some of these lines of sluices are of great length, as much as a mile or more. The water must also be conveyed to the claim by ditches or flumes, often from sources many miles distant, and sometimes also large dams require to be built to store the water for the dry season. The water is brought to the pressure box, usually situated on some neighboring hill, or high point, and from there is conveyed in wrought iron pipes to the bank where it is to be used.

The usual style of nozzle is the *Monster* and *Little Giant*; they have a ball and socket joint, enabling them to be turned in any direction. Everything being in readiness, then, the water is turned on, and washing through the shaft begins, this has to be done carefully at first to avoid rushes and caves, and a uniform slope to the mouth of the shaft must be preserved. As the washing progresses the timbering in the shaft is removed, till finally bed rock is reached when the claims may be said to be opened. As this bank recedes the tunnel or ground sluices leading to it are advanced. Immense quantities of gravel are in this way passed through the sluices, as much as 9,000 to 10,000 cubic yards per day.

The cost of washing averages about 4 cents per cubic yard, and gravel yielding 10 to 20 cents per cubic yard may be profitably worked. Water used in this way has tremendous power, will lift large boulders as if they were little pebbles, and carry everything before it. An anecdote, about one of the Hydraulic Mines in the States, illustrates this very well. They were introducing the Little Giant nozzle which has a ball and socket joint. Through some mistake this got away from the miner in charge, it began whirling around, killed 2 or 3 men, and levelled everything in the vicinity before the flow of water could be checked. Derricks run by a *Hurdy Gurdy* wheel are used to hoist boulders out of the way.

Water is also used for generating electricity for lighting purposes

I mentioned that it was necessary to obtain good dumping ground for the immense quantities of tailings. Ordinary streams would soon and actually do become choked up, and this method of mining has now become illegal in many of the Western States, because the rich farming land in the bottoms and valleys was rapidly being ruined by the rush of gravel from the mines in the hills. After a clean up, which takes place every 2 or 3 months, the gold amalgam is squeezed in canvas or buckskin bags, to rid it of the surplus quicksilver, and the remainder is retorted, cast into bags of bullion, and stamped with the companies' name.

Deep Placer mining by hand is resorted to when from various causes Hydraulic mining cannot be employed. It consists essentially in reaching the pay dirt by means of drifts and shafts, or both combined. The water is removed and kept under control by pumps, and the dirt is hoisted to the surface, where it is washed in sluices as before. In deep placer mining the miner has to overcome many difficulties. He may be troubled by water coming through porous strata, or he may strike a layer of quicksand, the timbering in the shafts and drifts must, therefore, be strongly, securely and tightly built, for the life of the miner may often depend upon it. Large water wheels also often require to be built, they are used for hoisting water, and are furnished with buckets which carries the water up, and empties it into sluices, one such wheel on Quesnelle River is 60 feet in diameter.

Sometimes also rubber hose is suspended across large rivers, to convey a supply of water to a desired point. One company in the vicinity of Clinton has an appliance of this kind crossing the Fraser River. Great ingenuity is exhibited by the miner in overcoming the many difficulties against which he has to contend, and in this country they have not been backward in this respect. As an instance of this, it is related that a California miner came up to Cariboo with the intention of introducing new and improved machinery, which he thought would revolutionize mining in this country, but after seeing the appliances in use, he returned saying that they had never had machinery equal to it in California.

Having thus given a retrospect of placer mining in British Columbia, and also a rough description of how such mines are worked, I will now pass on to mining proper, or *vein mining*. As an industry this is much more important than the transient prosperity produced by placer mining. It is lasting and durable, employs a large number of men, circulates a large amount of money, and extends trade and commerce; it fastens old industries and establishes new ones, and is an important factor in the general prosperity and wealth of any country. How important it is then that outside people should have some idea of our mineral wealth. As an industry in this province it is still in its infancy, and I therefore, only intend giving a short description of such localities as have been discovered within the last few years, and are supposed to be rich. These places are as follows:—Nicola Valley, Rock Creek and vicinity, Lillooet, North and South Kootenay, Cherry Creek, Cariboo, vicinity of Kamloops, Yale and Hope.

The Nicola Mines are situated on Stump Lake, about 30 miles south of Kamloops, with which place they are connected by an excellent wagon road. The mines were discovered about 5 years ago, and the Nicola Mining and Milling Company was organized to develop the claims. This company expended about $12,000, and during last season sold their property to a company of English capitalists, who so far have expended a large amount of money. They intend pushing their explorations rapidly during this season, and if the mineral increases in quantity as it now is doing, they will undoubtedly erect smelting and reducing works for which suitable land has already been secured. This company is said to have $20,000 of ore on its dumps.

Several other companies are also at work in this vicinity, among these are:

Messrs. Henderson & Patterson.
" Wright & Fletcher.
" Hepburn, Wilson & Dunsemin.
" McCullough, Jones & Deardon.
" Wilson & Turner.

These gentlemen have a large number of claims, on which a considerable amount of work has been done; and, judging from the quantity of ore extracted, they possess valuable properties. The minerals found are silver bearing, though gold is also found; they are as follows: Galena, Grey Copper, Copper Pyrites, Carbonates, &c.

The *Rock Creek Mines* are gold bearing, and were discovered in May, 1887, they are quite close to the International Boundary, and only some 12 miles from the old placer mines on Rock Creek. The ore on the surface was free milling and showed gold visible to the naked eye; as they worked down on the deposit this gradually changed into sulphurets which, though equally rich, are more difficult to work. A working test from a quantity of ore sent to San Francisco gave returns of $62 to the ton in gold.

Several companies have been organized to work these ledges, among which are prominent business men of Victoria. The Standard Oil Company of New York is also interested. A considerable amount of work has been done during the past season, and the probability is that during the present year a move will be made to bring machinery to the ground. Mines have also been discovered on *Boundary Creek* and on the *Tulimeen River* which appear to be equally valuable.

The *Lillooet Mines* are situated on Cayoose Creek, about 15 miles from the town of Lillooet, and were discovered during the latter part of last season. The ledges are gold bearing, and some 30 claims have been located. Several companies have been organized to develop the mines, which must be rich, as very good offers for some of the claims have already been made. One offer was that a particular company should bond its property for six months for $250,000, for which a 1-7th interest was to be given. Good offers to start stamping mills have also been made. The quartz is said to show *colors* almost everywhere when crushed by hand and washed.

North Kootenay includes Illecillewaet, Big Bend, and the mines in the vicinity of Golden.

I will first take up the *Illecillewaet Mines*, which are situated in the vicinity of Illecillewaet station. The Selkirk Mining and Smelting Co. have erected sampling works, from which they have shipped some 300 tons of ore to smelting works at Omaha. The products of the mines are silver bearing ore, principally Galena and Grey Copper, the latter being exceedingly rich in silver. The average value of the ore by the carload is 70 ounces of silver to the ton and 44 per cent. of lead. This company has expended a large amount of money, and employed many men in opening their mines, building trails, offices, mills, etc., and deserve great credit for their enterprise. They intend to build a cable road as soon as possible, so that the ore may be quickly carried from the mines to the railroad. Messrs. Corbit & Kennedy, who were the discoverers of these mines, own a number of claims, and have also organized a good company to work them, most of these ledges shew large bodies of ore, and look very promising. They intend pushing the work during the coming season as rapidly as possible.

Captain McCallam has a number of claims on Cariboo Creek in the same vicinity, which are said to be equally rich. Altogether some 225 claims have been located in this vicinity, and quite a town has been built at Illecillewaet Station.

About *Big Bend Mines* I can say very little, they are said to be rich, and produce both Galena and Gold, and I have seen some very fine specimens of the latter. There must be good indications of mineral, for several prominent members of the Canadian Pacific Railway have bought interests in one of the mines.

Mines have been discovered on the *Spellamcheen River* about 40 miles from Golden, and also on *Jubilee Mountain*, about 15 miles from the former place. The *Gold and Silver* Mining Co. have been pushing work, but met with an unfortunate accident last summer, in the shape of a destructive, fire, which burnt their mill, offices, etc., and destroyed much valuable property. This has delayed their operations, but they mean to go on again this summer. These mines produce low grade ore, but the ledges are large and will counterbalance this by the quantity of ore which can be extracted.

In *South Kootenay*, silver bearing ledges have been discovered in the vicinity of Fort Shepherd. They are situated on *Toad Mountain* and the *Pend d'Oreille River*. Assays have been obtained, going as high as 1,600 ounces of silver to the ton, and they are said to be the richest mines yet discovered in British Columbia, but this at present can only be a surmise.

Cherry Creek Mines. In this locality two ledges have been discovered, one silver bearing, the other gold bearing. The silver bearing ledge crosses Cherry Creek, just in the vicinity of the old placer mines. Assays of mineral from this mine show it to be extremely rich. I myself made one giving some 1,205 ounces of silver to the ton, and a working test from 2 tons of ore shipped to San Francisco gave 625 ounces of silver to the ton. About 12 miles from the above mines is situated the gold bearing ledge known as the McIntyre ledge, from its discoverer and principal owner. It is, I think, a good property, shews gold in several places visible to the naked eye, and *colors* can be obtained almost any place by crushing and washing the rock. A good wagon road has been built to these mines.

The *Cariboo Quartz Ledges* have been known for many years, but the greater portion of the work has been done within the last few years. The two principal companies are the British Columbia Mining Co., on Lowbee Creek, and the Island Mountain Mining Co., on Jack of Clubs Creek.

Both companies have done a large amount of work, and the latter company has machinery on the ground, which they hope to have in running order during the coming season.

Several very promising ledges giving good assays have been discovered up the *North Thompson River*, only a short distance from *Kamloops*, and money has been raised to explore them.

In the vicinity of Yale and Hope, a number of ledges have been taken up, and a considerable amount of work done. These ledges have been examined by I. H. Collier, a mining expert from England, and his report is very favorable to them.

The province then possesses mineral deposits in many different localities, which bid fair in a few years to become very valuable. This being the case, it may very reasonably be asked how it is that so little has been done towards the development and working of these ledges.

The delays may be accounted for as follows : Previous to the completion of the Canadian Pacific Railway, the province was out of the regular line of travel, few strangers therefore visited the interior, and the miners were practically unknown to the outside world, the married men of the Province then had to bear the burden of the work, and with their legitimate business to manage they could risk, comparatively speaking, only a small amount on development of mines.

The discoverers of the mines were almost without exception poor men, and they had either to struggle along as best as they could, doing what was required by law to hold the claims, or else they had to obtain help from monied men, which is often a difficult matter when both man and mine are unknown. Miners themselves are also somewhat to blame, in many cases they are given to exaggeration, and often represent their claims as being richer than they possibly can be, and the probability is that in most cases they do this in perfect good faith. This naturally makes men of capital chary and cautious about investing money in an enterprise, where in addition to the ordinary risk there may also be deception. Might I on this point then give a few words of advice, the discoverer sees wealth and fortune before him and is carried away by his excitement. Let him then when seeking assistance to work his mine try to give a cool, just, fair, and dispassionate statement of what he believes his property will produce, and I venture to say that the capitalist will be more impressed by his common sense, cool judgment and earnestness, than if he presented the subject in a dazzling light, which, at first, takes the fancy, but on more mature consideration must appear fanciful and unreal.

The mining laws of the Province have in one particular been somewhat defective, and when I say this, I have no intention of blaming the Government, for it is impossible to frame laws which will be perfect from the start, changes must be made when required, and they have always displayed a desire to make such changes when shewn that they were necessary. I refer to the regulation which specifies that a certain amount of work (now $100) should be done for a stated number of years on *each* claim to hold it. The result of this law was to hold the miner to do a little work on each individual claim, which practically had no effect whatever in developing the property. Now, however, this is changed, and permission may be had by a company holding claims on the same ledge to do the specified amount of work for a number of claims on a single one, which certainly shews in a much greater degree what the claims, as a whole, are worth, and is a direct encouragement for capitalist to invest.

These delays then have created doubts as to whether British Columbia will prove to be a profitable mining country or not. But these doubts are gradually and surely disappearing. With improved facilities for travelling since the completion of the Canadian Pacific Railway, many men experienced in mining affairs have visited the province, and the favorable opinion expressed by them is having a good effect, capitalists are now beginning to invest money in the mines of the country, and British Columbians may look forward with hope and encouragement to a time in the near future, when these doubts will have been wholly dispelled by the successful working and development of one or more of its mines.

In conclusion, let me say that I have as far as possible restricted this description of the mineral wealth of the province to what I believe is a plain statement of facts. Nothing I think could be more hurtful to an industry now in its infancy than a willful misrepresentation or exaggeration.

Mining affairs in this country have now arrived at that stage when examination of its mines is courted and invited. Let us hope then that capitalists will visit the province, see its mines, and judge for themselves, and if they do this I have little fear but that their opinion will be favorable.

I trust then that my paper will have been of some little service to you as an association, and that it may be the means at least in some slight degree of directing your attention to the capabilities of British Columbia as a mining centre, which will, I think, soon be of importance to our Dominion in general. The subject is an important one, and if in more capable hands than mine, would, I feel satisfied, prove an interesting one also. The paper has assumed dimensions far beyond what I had originally intended it should, a great part of it is taken up with descriptions of mining scenes long since passed by, and it might perhaps have been better either to have suppressed this first part altogether, or to have divided the subject and taken up part in the future; but in thinking over the matter, I decided in my own mind, that this could hardly be done, for one event leads on to another from the finding of the placer mines in the olden days to the discoveries of quartz ledges in comparatively recent days. I can therefore only apologize for taking up so much of your valuable time, and could I only feel that I had presented the subject in an interesting form I would be amply rewarded for my trouble.

THOMAS DRUMMOND.

DISCUSSION.

The PRESIDENT, E. J. RAINBOTH, made some interesting remarks on Phosphate and other mining in the vicinity of Ottawa.

J. S. DENNIS corroborated Mr. Drummond's statements concerning Mining in British Columbia, and added some interesting items from his own experiences.

* * *

RELATIONS BETWEEN MASTER AND MAN ON A SURVEY PARTY.

I would like to bring before the notice of our Association a subject which is of interest to our Profession, and as I am not certain of being present at our Annual Meeting, I take this method of expressing my opinions. As the proposition which I am about to make aims at increasing the efficiency of the survey party in the field, I am sure it will receive a respectful hearing from the members of the Association.

Every surveyor knows that the amount of field work, and to a considerable extent the quality of that work, which he can accomplish in a given season, depends largely upon the personal of his party, with respect to the competency of each man to do his work, the degree of alacrity with which he does it, and the general harmony and good will existing between the chief and his subordinates. It is very desirable that at the outset, each member of the party should know what his duty is, at least what his routine duties will be throughout the campaign; and it would be of great service to the surveyor to be able to show definite authority for the orders which he is giving or the discipline which he is enforcing. As it is, at present, each survey party is, to a great extent, "a law unto itself," and while the surveyor in charge is striving his best to proceed according to the best traditions of the profession, members of his party, especially green hands, think he is acting arbitrarily or capriciously; they think he is driving them harder than there is any need for, perhaps "to get his name up" in the Department, as being a great worker, and thus they resent his attempts to make the party do its honest duty, as an attack upon their rights. Being on Government work, they think they may take it easy, and that it is all the same whether much work or little is accomplished.

I believe this state of things would be materially remedied if the traditions and unwritten laws and regulations which govern our practice were reduced in writing to a concise Code of Regulations, to be approved by the Department of the Interior, and inserted in the Manual of Dominion Land Surveys, as being applicable to the survey parties in their employment. These regulations would then be made part of the "agreement" between the surveyor and each member of his party. In this way, every one would, from the beginning, know what he had to do and what he had to expect, and the surveyor relieved of the unpleasant task of, from time to time, promulgating laws which seemed to be supported by no authority but his own *ipse dixit.*

Contract surveyors also, when engaging men, could make these regulations part of the agreement of hiring.

I think the better way would be the appointment of a committee at the Annual Meeting now being held, who would undertake the work of preparing these regulations, and report at the Annual Meeting in 1889. It might be desirable, however, that the report should be printed and distributed to members beforehand, so that it could be intelligently discussed at the Meeting. I would be willing to act as a private member of such a committee; for chairman, we should have some one who has had a large experience in the North-west.

In order so make myself more clearly understood, and to excite some interest in the subject, I beg to submit the following scheme of regulations for the consideration of the Association, or of any Committee that may be appointed. Being a first attempt, it is necessarily crude and imperfect; it needs extending and filling up, and probably changing and correcting, but it is at least something tangible to put before the Association.

Yours very sincerely,

JOHN McAREE.

REGULATIONS FOR THE GOVERNMENT OF SURVEY PARTIES IN THE FIELD.

The Surveyor.—In issuing his orders he shall not use unbecoming language.

As he is responsible to the Government, each member of the party is responsible to him, and it is his duty to have a constant oversight of all the work that is being done; in this way he will be able to correct errors in methods of working, and make every one more proficient.

The Assistant.—The Assistant shall be diligent in learning his duties, and in acquiring a competent knowledge of every branch of his work. He shall assist his chief in all the labors of the latter, when so requested; take the responsibility of the party and of the work, in his chief's absence, uphold his authority, and in every way shew himself to be solicitous for the success of the expedition.

The Chainmen.—The rear chainman keeps the field book; if required by the chief, he must copy out his notes in ink, in resting hours; he is responsible for the care of the chain, for the correct making and planting of posts, marking bearing trees, placing of mounds, &c., and for the correctness of his measurements.

The leading chainman is responsible for the "arrows," sometimes he will have to carry the lunch for the field party; in a timbered country he may have to carry an axe to make posts, blaze bearing trees, &c. He may be required to leave his chain and go on the line to blaze or cut it out, build mounds, &c., in moving camp he may have to carry a pack, in short, be required upon emergency to do anything required of a laborer.

The Picketman.—In clearing the line through timber, the picketman keeps up sufficient pickets at all times to show the axemen the line, and directs the operations of the latter to prevent unnecessary chopping, to see that the requisite blazing is done, and that the line is sufficiently opened out above and below. In camp, he sees that the men grind their axes, mend harnesses, &c., and that everything is got in readiness for the exact work to be undertaken; the picketman is in short the foreman of the laborers of the party.

The Laborer.—The laborer must be diligent to make himself a competent workman, so as to become expert in chopping out the line, building mounds, managing horses, &c. He is responsible that the tools or implements with which he is working are kept always in good working order.

The Cook!!—The cook must take charge of all the Commissariat supplies and furniture from the first day of the expedition to the last. He is responsible that the supplies are kept in good condition and for their economical consumption. He must be careful that the supplies in the depot, in the carts, &c., are sufficiently protected against the weather, against the ravages of animals, &c.

When they are being transported, he must see that they are properly stowed, so as to avoid loss or damage during transit. For this purpose, the men must obey his orders and carry out his instructions. In the use of the supplies he must use his best skill and judgment, must avoid waste and extravagance, and always know how long the provisions on hand will last. He must fetch and cut his own wood, and fetch his own water, unless the distance from camp is too great, or when the party is on the march.

He is chargeable with the general care of the camp, when left alone with it, and at such times must look after the horses, if possible. When lunch is to be taken out to the field by a party, he must have it ready, so that they shall not have to wait for it. He must, if required, have breakfast ready at a stated hour without having to be called up in the morning, and he should provide himself with a time-piece.

GENERAL AND MISCELLANEOUS.

Every member of the party is responsible for the care of the property of the Government or of his chief committed to him, that it be not lost, or injured, and that it be kept always in good serviceable condition.

Only a limited amount of baggage will be conveyed for each man, and the surveyor may inspect each man's outfit to insure that he has proper and sufficient clothing, etc., for the campaign, and that no useless articles are taken.

To the assistant will be allowed   lbs. baggage.
  " chainman   "   "   "   "

To any other member of the party will be allowed   lbs. baggage.

No one shall take firearms unless by the consent of the surveyor in charge.

Grinding of axes, spades, etc., helving of axes, etc., making new helves, etc., repairing harness, greasing cart axles, etc., marking posts, tins, etc., repairing any part of the outfit, etc., must be done during spare time and resting hours, as on rainy days, at night, etc.

The horses should be looked to every day, to prevent straying, to recover any that may be cast, mired, etc., also to ensure that they can get water. The men take this service in rotation. The only member of the party exempt being the chief and his assistant, the cook and chainman who keeps the fieldbook, except that when the cook is alone in camp, he must look after the horses as well as he can.

Every one must be ready for breakfast when it is announced, and ready for the service of the day when the meal is concluded. If going out on the line or on other work, he must have his instrument, chain, axe, spade, cart, horse, or whatever he is to use, made ready and fit for immediate service, before breakfast, and the cook must have lunch put up by the time the field party are ready to start.

On the march or when moving camp, all hands arise together in the morning, and proceed to pack up and load up, and get *en route*, working without intermission, except for eating breakfast. If horses are being used, one or two hands will be dispatched for them, while the packing up is being done, and the baggage of these will be packed up by their comrades in their absence. The horses must be brought in in time to be ready when the camp is ready to move, even if those who fetch them have to turn out much earlier than the rest of the camp.

Each man who drives a team is responsible for the care of his horse and cart, and of the goods comprising his load. He must see that the harness is kept in repair, and that it does not gall or hurt the horse ; that his cart axles are kept lubricated, that the goods composing his load are protected against the weather, and properly stored, etc., so as not to be damaged or wasted in transit. The driver of a loaded cart must not ride upon it.

After the tents are set up the horses must be taken care of, all about the carts made snug, and the out-door work generally attended to, before any one proceeds to attend to his personal comfort.

On the march the men must fetch wood and water for the cook ; this is a general rule.

SUNDAYS.

Since Sundays are counted in among the days for which pay is allowed on survey parties, every member of the party is under obligation to do his share of the necessary work on that day, such as the care of the horses, taking astronomical observations, travelling in exceptional cases, and even working on the line, in extreme cases.

Hours of Labor.—With regard to this matter, it is to be borne in mind that as there is generally of necessity a good deal of lost time, from rainy weather, etc., during the time the party is under pay, this lost time should be made up by working extra hours at other times.

Advances on account while on the Survey.—Unless a special agreement has been made, an employee's wages are not due until the completion of his period of service. Any advances he may receive from the surveyor, before he is finally paid off, is an act of grace on the part of the surveyor. After serving one month, however, he may demand advances from time to time, sufficient for the actual necessities of clothing or medicine while engaged.

Small Parties.—On small parties numbering no more than five or six all told, every member of the party below the surveyor must assist in the general work, driving and taking care of the horses, fetching them in the morning, etc., loading and unloading, cutting wood, etc., etc.

JOHN McAREE.

DISCUSSION.

At the close of his paper, Mr. McAREE stated that as it was the intention to appoint a Standing Committee on Land Surveying, he would be quite satisfied if the matter were referred to the same instead of appointing a special committee.

The PRESIDENT recognized the usefulness of Mr. McAree's remarks upon the examination of baggage, also with regard to firearms.

OTTO J. KLOTZ thought that it was impossible to define any man's duties; that if a surveyor were a greenhorn, he would be humbugged anyway, rules or no rules. He did not think that any rule would make a man more serviceable than he naturally was. He did not believe in contracts, except to scare the men employed. He believed in hiring every man as a laborer.

G. B. ABREY said he also believed in hiring every man as a laborer, and did not think that rules could be made to govern their service, but that they should do anything required of them.

DR. BELL thought there should be some such rules or record, and told an interesting anecdote illustrating the same, and bringing up the question of whether a man if discharged should have his transport to civilization supplied and paid for. Dr. Bell agreed with Mr. McAree in the matter of firearms, and also on the point that the men should work while there was work to be done. He said that example went a long way, and that the surveyor should not be too proud to do anything at all, and so set a good example. He denounced the fact of assistants being forced upon the chiefs of parties by the Government as supplying incompetent men and loosening the surveyor's control over the party.

T. D. GREEN said that he also had had quite an experience with Government Assistants, for though told that they could discharge them if found incompetent, still every surveyor would think twice before doing so.

J. S. DENNIS agreed with Mr. McAree in some respects, in others, not. He agreed with Mr. Klotz and Mr. Abrey that every man should be prepared to do anything he was told. He thought, however, that some such suggestion as Mr. McAree had put forward might be carried out. With regard to payment of men referred to by Dr. Bell, he thought the legal aspect of the case as understood, required you to return the man to the place he was taken from, and that it was the custom of the Department of the Interior to do so. He agreed with Mr. McAree about not having more baggage than absolutely necessary, and if some certain quantity were the rule it would strengthen the Surveyor's hands in managing his men. As to firearms, he agreed altogether with Mr. McAree. He doubted if it could be embodied in the Manual of Survey, but thought it might be used to advantage if a memorandum were issued by the Association.

G. B. ABREY told an incident of discharging men in the North-West, and of being summoned before Stipendary Magistrate Richardson for wrongfully discharging them, on the ground that they had been engaged for the season. He was compelled by the magistrate to give them an extra month's pay.

Resolution No. 25 referred the subject of Mr. McAree's paper to the Standing Committee on Land Surveying, to be reported upon at the next Annual Meeting.

MR. MCAREE signified his satisfaction at this course.

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METHODS OF DETERMINING GEOGRAPHICAL POSITIONS.

The title I have chosen covers a very wide extent, too wide, in fact, to be fully treated in a short paper,—a volume, or many volumes, would be filled before the subject was exhausted. It includes the whole science of geodesy as well as astronomy, the description of the instruments used in measuring angles, the practical methods of observing the angles of a triangulation, the measurement of base lines by means of the fine modern appliances, measurements by chain, surveying and astronomical instruments of all kinds and their use, the determination of the general figure of the earth and its local irregularities with all the mathematical processes and physical investigations connected therewith, all these are involved in a full treatment of the subject.

In the present paper, however, I intend to confine myself to a few brief notes upon some of the methods, by which the latitudes and longitudes of places may be found with sufficient accuracy for the purpose of ordinary map making.

A glance at the map of Canada shows how little is accurately known of the geography of the vast interior. Main routes of travel appear merely in skeleton form, roughly sketched in, miles perhaps out of their proper position; while off these routes nothing is known, the map is a blank.

It would be well that all travellers, whether on business or pleasure, should endeavor to obtain as much accurate information as possible of the geography of the country traversed. My object in writing this is to mention a few of the more convenient methods by which, with little trouble, with the help of simple instruments, such information may be procured.

The necessary instruments are a good watch and a surveyor's transit theodolite, having a vertical arc. For the latter a sextant or reflecting circle with an artificial horizon may be substituted, and is preferable on account of its greater accuracy, portability, and rapidity and convenience in using. Those, however, who have to carry an angular instrument for other purposes will use it for their observations in preference to carrying an additional instrument. With the theodolite the reading of the two verniers in each case cuts out, in the mean, the eccentricity of the verniers. With the sextant of the ordinary pattern, having but one vernier, this is not the case. It is, therefore, necessary to test the sextant by reading angles measured also by other means, so that the actual error of each part of the arc may be tabulated and applied as a correction to angles read with the vernier. Uncertainty that the eccentricity remains constant affords the chief objection to thef sextant. A variation will occur at every reading from the drag o the vernier, the action of the tangent screw, etc., unless the fitting of the centre is very good.

The reflecting circle having two verniers avoids this cause of error. The reading of the two verniers moreover, cutting out accidental error of the reading, makes it possible to get results equally as good as given by the large nautical sextant, with a much smaller and, therefore, more compact circle.

A high power telescope is advisable on a good reflecting circle. Most reflecting instruments are not furnished by the makers with telescopes of sufficient power.

Both the reflecting instruments and the transit theodolite are subject to index error. In the former this is readily found by observation of the coincidence of images at the zero point. With the theodolite it can be found by a second observation of the altitude of the object in the reversed position of the telescope; but this in the case of an object which is observed at its highest altitude may lead to error by reason of the object having passed its highest point, and being at a lower altitude at the time of the second observation. It may also be found by readings in the two positions of the altitude of a terrestrial object.

The latitude of a place may be very readily found. The simplest method is that by meridian altitude of the sun or a star. The observation is made by following the object until its highest altitude is reached, when the angle read gives the meridian altitude.

Observation of the altitude of the pole star at a known time is a good method. Stellar observations give better results than those on the sun, on account of the better definition of the object given by the telescope.

When the latitude is required with greater accuracy, a number of observations of the sun or a star may be taken near the meridian, noting the time of each observation. The observations are then reduced by the method of "circum-meridian altitudes." A really accurate result can only be got by star observations, taking complete altitude observations on two stars,—one north of the zenith and the other south, the two stars having as nearly as possible the same altitude. The mean of the results cuts out errors in refraction as well as constant instrumental errors, such as the eccentricity, also periodic error of graduation.

Observations on the sun should be taken on each limb of the sun in succession to eliminate enlargement of the sun's apparent diameter or indistinctness, arising from low optical power of the telescope.

The method of circum-meridian altitudes for latitude, as well as that by altitude of the pole star at any time requires a knowledge of the time, which, therefore, must be found by observation. Observations for time must also be taken, whenever the longitude is desired, by astronomical observations. We, therefore, pass to some methods of determining it.

The simplest method is by altitudes of the sun or a star. The object should be as near the prime vertical as possible, without being near enough to the horizon to introduce unknown or variable refraction. When possible two stars should be observed east and west of the meridian, for reasons similar to those given above for the use of north and south stars for latitude.

Equal altitudes of the sun before and after noon, or before and after midnight, is an excellent method with the sextant. Equal altitudes of stars is too difficult an observation to be recommended at least with the sextant.

For latitude observations it is not necessary to know the time very closely, but in longitude determinations the error in the time appears directly, so that all possible care should be taken to secure accuracy in the observations.

From an observed altitude the time may be calculated by the usual spherical formula for the sine of half the hour angle in terms of the sides of the triangle, but the work may be shortened by using, with subtraction logarithms, the formula

$$\cos t = \frac{\sin h - \sin \phi \sin \delta}{\cos \phi \cos \delta}$$

where t is the hour angle, h the altitude, ϕ the latitude and δ the declination.

I may here remark that as far as the sun is concerned, an almanac may be dispensed with by using a table given at the end of Bremiker's Logarithm Tables, a book which is in the possession of a good many Dominion Land Surveyors. This table gives, by a simple interpolation, the sun's declination and semi-diameter, and the equation of time, for any day of any year.

Similar tables might, perhaps, be constructed to give the right ascensions and declinations of fixed stars with sufficient accuracy for most purposes, since the principal terms of the corrections for precision, mutation and aberration by which the mean places of stars at any epoch are reduced to apparent places at a given date, either vary directly as the time, or have a yearly period, or have a nineteen year period. Hence tables might be constructed, giving for some epoch the mean places of the principal stars, and the corrections to be applied for certain years and certain days of the year. There would be two or three interpolations however, and so the almanac would be preferred.

With the transit theodolite, time may be observed by meridian transits, but unless great accuracy is wished for, this method will be found less convenient than the method of altitudes, on account of the longer time which the observation usually takes. A similar objection will apply to transits over the prime vertical for latitude, which is a very accurate method and one which can be used when there is no vertical circle, or only a very small one, on the instrument. Nothing is gained by it in accuracy, unless the striding level is sufficiently sensitive to give a reading less than the reading of the vertical circle. Needing some calculation to prepare for the observation, and necessitating a long after calculation to give the results, this method can hardly be considered suitable for a rapid survey. The time, moreover, must be known very accurately.

If the watch can be relied upon to keep a steady rate, the local time, given by observations, gives by comparison with the watch-time of the reference meridian the difference of longitude from it. Time pieces usually have a different rate during travelling from what they have when stationary, the difference being frequently very considerable. Hence care must be taken to properly determine the travelling rate, by observing twice at the same place before and after the journey. If during the trip a stay is made for several days at one place, the watch then remaining at rest, it is well to observe at the place as soon after arrival and as soon before leaving as possible, so that the stationary rate so found may be separated from the travelling rate.

With care, very good longitudes may be got by this method. Two or more watches, however, should be carried if the best results are wished for, as the rate is liable to irregularities from changes of temperature, jolting during transport, etc.

There are several methods of determining longitude by lunar observations.

1. The method of lunar distances with the sextant. This method is subject to the principal defect that the low magnifying power of the sextant telescope gives an imperfect definition of the moon's limb, making the moon appear larger than it is. This error is eliminated by taking the mean of a number of observations before and after full moon. This necessitates a stay of several days at a place. The calculation to obtain the longitude from the observations is long. It is difficult to get a result true within some miles by this method.

2. The method by moon culminations, or transits of the moon over the meridian. This method is much more accurate than lunar distances, and is the best method usually available, as well as the simplest. Observations on both sides of the full moon are necessary in this method also for the best results.

3. The method by occultations of fixed stars by the moon. This observation consists in noting the time at which the star disappears under the moon's limb, and again when it reappears. The observations can be made with great precision. Unfortunately occultations of stars of sufficient brightness to be observed with an ordinary telescope occur but seldom, and an intricate calculation is necessary to obtain the approximate time of occurrence for the purpose of preparing for the observation. The method is well worth trying however, should a star of the third or fourth magnitude be occulted. Fifth and sixth magnitude stars will be found rather small for ordinary telescopes. I hope to give, at some future time, a method by which the calculation for prediction can be shortened and simplified.

Eclipses of the sun and moon may be used for longitude, but accurate results cannot be got from them.

Eclipses, occultations, and transits of Jupiter's satellites may also be employed, but this method also is not capable of much precision.

Another method is the comparison of time at two places not very far apart by visible signals, such as the bursting of a meteor, flashes of gunpowder, etc.

Where the electric telegraph is available, it furnishes the most accurate method known for comparison of the local times at two places to give their difference of longitude. The various refinements used in connection with this method when the highest precision is aimed at, such as the sending of signals in opposite directions, equalization of resistances, etc., may be dispensed with, and a result obtained from the receipt of a simple hand signal made at the further station which will be more accurate than any of the other methods can be made without very long continued observations.

This method is particularly applicable along the C.P.R. main line in Ontario, where the country has not been surveyed, and maps, even of the country along the railway line, are not reliable. The time is telegraphed from Montreal to each station every day. On the whole it appears that the methods most within the means of travellers are the simple methods of latitude by meridian or circum-meridian altitudes, or altitudes of the pole star, and longitude by the carrying of watch time from some known place. Lunar observations to be taken when remaining some time at a place.

Longitudes may be very well laid down by means of even the roughest kind of track survey when it is properly checked by latitude observations. The plan adopted by myself in several rapid track surveys was to stop at noon, wherever I might be, and observe the meridian altitude of the sun with the reflecting circle and artificial horizon, the whole observation, with the unpacking and repacking of the instruments, occupying less than ten minutes. Then at night two or three altitudes of Polaris and the same of a star on the meridian south of the zenith gave a good latitude, while stars east and west gave the watch correction. By means of the latitudes and longitudes thus obtained, the roughly observed intermediate bearings and distances were checked in, affording a very good sketch of the route. The intermediate courses may be put in either by pacing, odometer, estimation of speed of travel, micrometer measurement, or any method which the character of the country and the quickness of travel renders available.

W. F. KING.

ELECTRICAL APPARATUS IN THE DETERMINATION OF LONGITUDE.

Of the various methods for determining longitude, that by means of the electric telegraph is pre-eminently the most accurate.

In nearly all the other methods, the moon is the chief factor, and of all celestial bodies the moon is the most difficult for investigation.

Hence, whenever a longitude determination is to be made of a place which is connected by wire with some known point, the telegraphic method is always used.

The principle involved is simple. One observer is stationed at each of the two places, where, by means of a transit instrument placed in the meridian, he observes the transit of north and south stars from which he deducts his chronometer correction, that is the local sidereal time.

By means of the electric telegraph the time of each chronometer for an absolute moment is obtained, and this combined with the chronometer correction of each gives the difference in time between the two places, which is equivalent to the difference in longitude.

Were the instrument placed exactly in the meridian, its axis level and no collimation error, then the difference between the apparent right ascension of the star and its time of transit, as noted by the chronometer, would be the chronometer correction ; but as these conditions can never be fulfilled, it is necessary to determine the instrumental errors.

In preparing the programme of stars for the past three years for the longitude work, I have adopted the following scheme : Each programme consists of twenty stars, in four sets of five stars each Each set has one polar and four time stars,—the former for the determination of azimuth and collimation errors, the latter for the chronometer correction. The instrument occupies the four positions,—clamp east, clamp west, clamp west and clamp east.

Between the second and third sets is an interval of about an hour, during which time each observer places his chronometer into the circuit of the telegraph line, whereby each chronometer records at both stations, and thus the time shown by each at an absolute moment is found.

The same stars were always observed at each station to eliminate error of star places. The positions were obtained from the Berliner Astronomisches Jahrbuch.

In the reduction of the transit observations another correction has to be applied; it is that of rate.

In our assumed ideal case of a perfectly adjusted instrument, although each star transit would give the chronometer correction, the corrections deduced from different stars would not be equal to each other on account of the rate of the chronometer, each correction being only true for the instant of transit of that star from which it was deduced, so that in practise, when simultaneously reducing a number of transits to some common time, generally that of the exchange of telegraphic signals, a correction for rate must be applied to each star. If the chronometer is losing the sign of the rate correction before signals will be negative, and after signals positive, vice versa, if gaining.

This question of rate, I consider the most difficult problem in the field work of longitude determinations. Chronometers have more idiosyncrasies than any other astronomical instrument. The great desideratum in such a time-piece is that it have a uniform rate, be it gaining or losing.

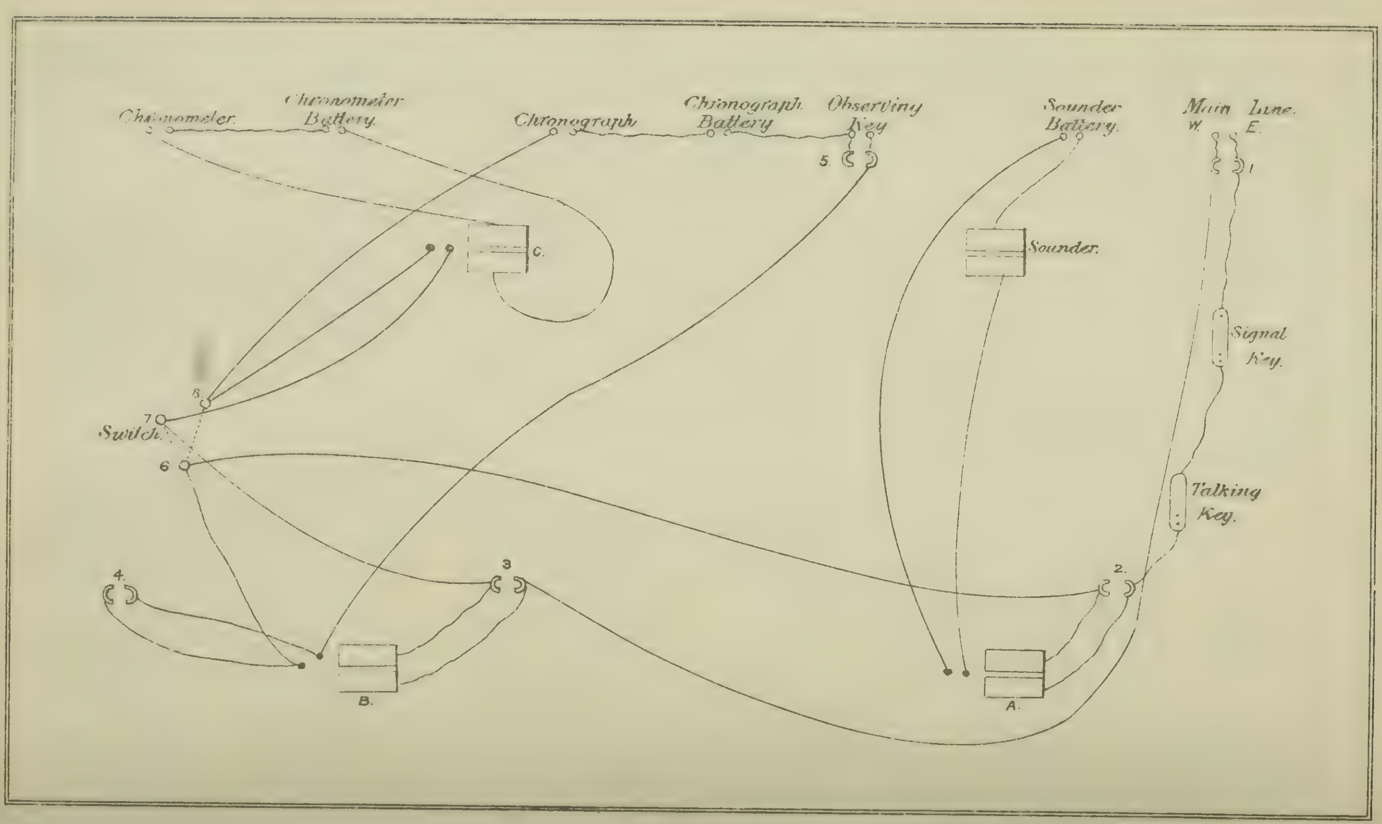
By experiment it has been found that rate varies as the square of the temperature; or, to state it more definitely, there is a certain temperature, called the temperature of compensation, at which a chronometer has its fastest running, for any other temperature the rate is found by multiplying the temperature constant (which must be determined for each chronometer) by the square of the difference of temperature, and adding this quantity to the former rate. Expressing it in a formula we have

$$r' = r + z\,(\theta - \theta')^2$$

in which θ is the temperature at compensation, r the rate at $\theta°$, and z the temperature constant.

Reverting to the reduction of the transits, after applying the corrections for rate and inclination of axis, there still remain the three unknowns: the azimuth and collimation errors and the chronometer correction.

From experience, I have been led to assume that the azimuth and collimation remain constant during the interval of sets one and two, and similarly for sets three and four, so that in computing one night's work we have two groups, each of ten condition equations, from which the three normal equations are formed and the three unknowns found.


Chronometer.
Chronometer Battery.
Chronograph
Chronograph Battery
Observing Key
5.
Sounder Battery.
Main Line.
W.
E.
1
Sounder.
C.
Signal Key.
8.
7
Switch.
6
Talking Key.
4.
3
2.
B.
A.

It would be more satisfactory to determine the collimation independent of the transit observations, so that there would remain only the two unknowns: azimuth and chronometer correction.

In a fixed observatory this can easily be done by means of collimators, but in the field we are dependent upon circumpolar stars, noting the time of transit over half of the threads, then reversing and again noting the time over the same threads.

It frequently happens in the field that no suitable polar star is available just before or after the regular transit observations, and hence the collimation is not obtained independently. Even if it were obtained, it is questionable, from the unreliability of its constancy, whether its application would give a more accurate value of $\delta\tau$ than when it is treated as an unknown in the condition equations.

I may cite a peculiar case of change of collimation. During the past season I was observing at Port Arthur, in July, the collimation varied between $-^{s}.06$ and $-^{s}.10$. Then followed an interval of about a month, during which time no observations were taken; resuming work in the latter part of August, the observations gave the collimation as varying between $+^{s}.33$ and $+^{s}.37$. The instrument had remained mounted during the interval, and there was no looseness of screws carrying the diaphragm. The only known change of conditions was a lowering of the temperature of the air.

Having given a cursory review of the observations themselves, we now turn to the subject of this paper, "Electrical Apparatus in Longitude Work," and I will confine myself to that used by Mr. W. F. King and myself, each of us being provided with similar apparatus.

Wherever we observe the telegraph line is cut and brought into the observatory, where it is attached to the apparatus, of which the accompanying is a plan. (See Figure.)

A Talking relay

B Signal relay

each of 204·7 ohms resistance at 65° F.

C Pony relay for chronometer

1, 2, 3, 4, 5 are cut outs, with the necessary plugs.

The whole apparatus is neatly arranged on a mahogany board.

One gravity cell is used for the chronometer and one for the sounder, and two Laclanché cells for the chronograph, the gravity battery being found rather weak for the chronograph. As the two forms of battery are in circuit for some minutes only, no drawback results from their combined use, which otherwise would not be the case, polarization taking place.

The talking relay and its accompanying sounder could be dispensed with and the signal relay used instead, the sound being taken from the working of the armature thereon. The latter relay has split cores, whereby its quickness of action is increased, the electric current being more rapidly discharged.

The signal key differs from the ordinary talking key in that the anvil is placed at the back, so that when the key is depressed the circuit is broken instead of made as ordinarily.

Neither a galvanometer nor a rheostat was put into the circuit, the non-application of either being found to be unessential.

The chronograph used was the standard register of the Western Union Telegraph Company, and served its purpose well. It unreels about an inch per second, but this quantity can be increased or decreased by means of the governor in the mechanism. Its only disadvantage compared with the chronograph of observatories is that each record is on a separate tape, many accumulating during a night's work, whereas on the other the records are on one sheet. Its electro-magnet has a resistance of about 4 ohms.

The special appliance to the chronometer to make it serviceable for telegraphic work is that the second hand, which makes one revolution a minute, is attached to a wheel having twenty-nine teeth, the thirtieth tooth having been filed away, the vacant space causing the omission of the tick, which would otherwise mark the fifty-eighth second of the minute. By this means the beginning of the minute is identified. The remaining teeth act upon a delicate jewelled spring, which breaks an electric circuit at the passage of each tooth, that is every two seconds, the break being shown on the chronograph by breaks in the line of depression made by the style, which is attached to the armature, upon the tape.

When the apparatus is not required for work, a plug is inserted at 1 which then short-circuits the main line at 1.

When used for speaking only, plugs 1 and 2 are taken out and 3, 4 and 5 are left in. The current then passes through signal and talking keys, through relay A, which works the sounder, to switch through 6 7 and back through plug 3, without passing through relay B and out into the main line.

The circuit of the chronometer and its battery always remains the same, not being affected by any other current under the various conditions in which the apparatus may be used.

For speaking and at the same time to record the beats of the chronometer (each chronometer on its own chronograph only as when recording observations), that is not sending nor receiving beats over main line, the arrangement remains as above described. In this case the local circuit of the chronograph passes from the battery through the chronograph to 8, thence to one of the points of chronometer relay C which breaks the current to 7 across switch through 6 to one of the points of relay B (there being no current through this relay, its points are apart), thence through plug of cut out 4 to other point of relay B, thence through observing key or plug of cut out 5, completing the circuit at the battery, whence it began.

When plugs 1, 3 and 4 are taken out and switch is in position 6 7, then the apparatus can only receive signals over main line, but cannot send any. This arrangement is sometimes necessary when alternately arbitrary signals are given in case the beats of the two chronometers are co-incident or so nearly so that their breaks cannot be identified in the chronograph.

Finally when it is desired to send and receive simultaneously chronometer beats the switch is placed over 6 8, plugs 3 and 4 taken out and plug 2 put in (this is to cut off relay A and the sounder). Now the main line current passes from E through the signal and talking keys to 6 through 8 over the point of chronometer, relay C which here breaks the main line circuit to 7, thence through relay B which breaks the local chronograph circuit at points of relay B, thereby recording main line break, and finally out by W. (It is customary to speak of the electric current as entering by one wire and going out by another, similar to water running through a pipe; that is only relatively so, as there are continuously two currents the + and — flowing or passing in opposite directions towards the terminals of the line and there discharging into the earth). In this case the local chronograph circuit is shortened, the wires from cut out 4 to points of relay B, and those from 7 and 8 to points of relay C being cut out.

It sometimes happens that the beats of the two chronometers are co-incident or so nearly so that it is impossible to identify them on the chronographs, when such is the case another method than that last described must be adopted.

It consists in each observer sending alternately arbitrary signals. To do this the switch bar must be placed in position 6 7, so that the main line current is not broken by the chronometers, the arbitrary break being made with the signal key; otherwise the arrangement is as described last.

The arbitrary signals will then be recorded on each chronograph, which have their own chronometer beats recorded also.

The following equations will illustrate the method of arriving at the quantity sought:

1° O sending signals.

Set $O =$ the distance (in time) of arbitrary signal from preceding second break of O chronometer on O chronograph.

$W + \mu =$ the distance (in time) of arbitrary signal from preceding second break of W chronometer, on W chronograph.

μ being the time of transmission of electric fluid from one station to the other.

2° W sending signals
then similarly as above

$W' =$ distance on W chronograph.

$O' + \mu =$ “ O “

Set $a =$ difference (fraction of a second, the minutes and seconds being known) between the two chronometers.

then $O = W - \mu + a$

$W' = O' - \mu - a$

hence $a = \dfrac{(O' + O) - (W' + W)}{2}$

which gives the quantity sought.

The chronometer beating half sounds breaks circuit every four beats, that it is every two seconds, but omitting the fifty-eighth second, whereby the minute is identified on the chronograph record as previously explained.

The break-circuit is preferable to the make-circuit, especially on account of the greater potential of the current at opening than at closing; in the former the induced or extra current is in the same direction as the primary, thereby increasing its strength, whereas in the latter it is in the opposite direction, so that the primary does not obtain its maximum strength until after the lapse of a short interval of time.

This phenomena is distinctly shown on the chronograph, which is of the tape-register type. The end marking the break is sharp and distinct, that showing the make is far less so, but the line immediately increases in distinctness. The scaling of the tape is reduced to the one hundredth of a second.

In the following table are given the differences between the chonograph records when both chronometers are registering simultaneously at each station. This difference equals twice the time of transmission of the electric current. The time of induced current is eliminated.

If $x =$ absolute distance between the two chronometer beats O and W.

$c_o\ b_o\ r_o =$ time of demagnatization of cores within coils of chronometer, signal and chronograph relays respectively of O instruments. Similar designations for W instruments.

$\mu =$ time of transmission of current, then on O chronograph we have

O_o to $W_o = x - c_o - b_o - r_o + \mu + c_w + b_o + r_o = x - c_o + c_w + \mu$. On W chronograph.

O_w to $W_w = x - c_o - b_w - r_w -^{\mu} + c_w + b_w + r_w = x - c_o + c_w - \mu$ hence

O to $W = x - (c_o - c_w)$.

The two pony relays being similar, the quantity $c_o - c_w$ is extremely small and may be neglected.

Subtracting the two equations gives us twice the time of transmission, as equal to the difference between the linear measures (expressed in time) between the breaks of the two chronometers as shown on the two chronographs.

That the time of transmission between two stations varies is shown by the following results, and this difference must be mostly due to changes in the electrostatic condition of the atmosphere, (including thermometric and hygrometric), as the electro motive force, the wire, the apparatus and its adjustments remain constant or nearly so during the observations at a station.

In exchanging chronometer beats, the chronographs were allowed to record for a minute at a time, so that thirty measures of the quantity sought were obtained. The mean of these was always taken, and to allow for differential rate of the two chronometers, the mean was accepted as the absolute value at the half minute of the time of recording.

Date.	Stations.	Distance.	Difference.	Mean.	Deduced Velocity.
1885.		Miles.	s.		Miles.
June 14	Seattle, Victoria..........	317	.180	.209	3030
" 15			.238		
" 19	Seattle, Kamloops........	427	.194	.155	5510
" 21			.142		
" 22			.146		
" 24			.152		
" 26			.140		
August 11	Port Moody, Kamloops....	239	.068	.067	7140
" 12			.066		
1886.					
August 15	Kamloops, Revelstoke......	129	.030	.023	11220
" 16			.020		
" 17			.019		
Sept'ber 7	Kamloops, Field..........	258	.047	.040	12900
" 10			.056		
" 11			.032		
" 12			.027		
October 2	Kamloops, Calgary.......	391	.063	.061	12820
" 3			.046		
" 10			.074		
" 31	Kamloops, Winnipeg......	1230	.262	.257	9580
Nov'ber 9			.231		
" 10			.256		
" 12			.255		
" 14			.282		
1887.					
July 1	Winnipeg, Wapella.......	235	.069	.063	7460
" 2			.080		
" 3			.051		
" 5			.053		
" 22	Winnipeg, Port Arthur....	430	.075	.073	11700
" 26			.083		
" 27			.066		
" 30			.070		
Sept'ber 30	Winnipeg, Kalmar........	110	.024	.024	9200
October 3			.026		
" 4			.024		
" 5			.022		

The most of the differences given above are the mean of a number obtained each night.

It will be seen that besides the fluctuations in the velocity between two stations, there is the more apparent one for different distances, where difference of insulation, wire and climate come into play.

In the above results, the wire of the telegraph line was nearly all of No. 9 guage, although on the Pacific Coast end some No. 6 was used, where there were also 90 miles provided with porcelain insulators, otherwise glass ones support the wire. The Canadian

Pacific has now a No. 6 wire with porcelain insulators across the continent, but that line was generally too busy to be utilized for our work.

It may be remarked that in the summer of 1885, when working from Seattle, there were continuous bush fires interfering with the working of the line, the heated wires decreasing the current, and probably the velocity.

The mean of the above results leaving out the cable line (27½ knots), between Seattle and Victoria, gives 9700 miles as the velocity per second of the electric current. This must be understood as the average velocity on telegraph lines of No. 9 wire.

OTTO J. KLOTZ.

DISCUSSION.

After Mr. Klotz had read his paper, the members present gathered around the table, where he and Mr. King had set up the apparatus, batteries and the two chronometers, everything operating as in longitude work.

Numerous questions were asked, and everything was fully explained, so that the members were highly pleased with the practical illustration.

RANCHING AND IRRIGATING IN BRITISH COLUMBIA.

British Columbia, as a Province of the Dominion of Canada, has received more than a passing attention.

The place has been known by hearsay for years, and its fine climate, fertile soil, luxuriant pastures, massive timber, delicious fruit, enormous mineral wealth and unlimited fisheries, to which may be added its picturesque mountain scenery, have given it a reputation exceeding that of any other Province in the Dominion of Canada.

While glowing pictures may be painted of almost any country, and correctly so, it does not follow as a consequence, that wealth and the means of living luxuriously will be at once offered to persons who find themselves in these countries without wealth to commence with.

During the last two seasons, while engaged in surveys in the Kamloops District, which is supposed to be second to none in the Province of British Columbia, I had the opportunity of becoming acquainted with quite a number of the early settlers and their methods of life.

As the level tracts of land, when compared with the mountains, form but a small percentage of the whole, the greater portion of the country will always be used for pasture land, and hence the adaptability of this part of the Province to the raising of cattle and horses. Some twelve years ago when there were only a few settlers in this locality, those who were lucky enough to possess a small band of cattle and horses are to-day among the wealthy of the country.

At that time, before the pasture had been eaten down, all the early settlers had to do was to "round up" their stock once a year and brand them.

"Rounding up" is generally accomplished in this way: The stockmen with their assistants start out on a branding expedition in the summer, several parties frequently joining forces, and when they come across a band of cattle they are driven into the nearest coral and the calves branded with the registered brand of their respective owners.

To facilitate enclosing the animals, points are selected generally where the natural configuration of the country will be favorable for bringing them together. I have found myself following an open ridge, or valley in the woods, until at a distance on each side I could see either an artificial or natural barrier, and the space would become narrower until they come together at the entrance to the coral which is a high wooden enclosure generally, built in two parts with a narrow passage between the two.

By means of bars which can be manipulated from the outside of the fences, the animals can be let into the narrow passage and through into the inner department at pleasure. The animals are detained in this passage, into which they are driven singly, and branded and then allowed to pass into the other department. Sometimes it becomes necessary for a man to go on foot into the coral and then he has to look out for squalls, for while the cattle seldom turn on a man when mounted, yet if corned closely they will sometimes rush at a herdsman on foot, and woe betide him if he be not active.

This operation of "rounding up" and branding is carried on more or less during the latter part of Summer and in early Fall. Those stockmen who have but a few head and can manage to collect them themselves with one or two assistants will not be engaged more than two or three days, as they don't need to join the larger parties. The people usually make themselves at home wherever night overtakes them while engaged in this work, that is, they stay at the ranch of the nearest interested party.

Ten or twelve years ago this "rounding up" and branding was all that the stock-owner had to do, and as a result we find a number of wealthy stock-owners who are now able to purchase from the Government the pasture lands which they have been using free.

There are not the same facilities for becoming wealthy now that there were years ago, the pastures having become exhausted through over-stocking as wealth increased and stock became more numerous. The hills where grass used to be knee deep all the year around became bare, and in the Fall when growth ceased it became evident that feed would have to be procured for winter use.

This gave rise to great competition, and the ranchmen began to explore the mountains for meadow lands which are sometimes found far in the timber on the mountains. The grass is cut and the hay put up in stacks. Usually sheds facing the South are built as a shelter from the cold winds which generally come from the North and Northwest. A small shanty is put up for the accommodation of the party or parties appointed to feed the cattle, and all is in readiness for the winter which generally begins in December and becomes severe about Christmas.

The animals are gathered in from all parts, and you will often find your neighbor's cattle along with your own, and some of yours will probably have been driven in with the cattle of a neighbor some twenty or even fifty miles away. In this case you will notify the man whose cattle you have that you have so many head with his brand, and it is an understood matter that rather than come after the cattle in winter time he will compensate you for wintering them, and you will do the same for the cattle you have failed to get home.

In some seasons the cattle get much scattered and it occupies a large share of the winter in tracing them all up, by no means a pleasant task. In the summer time riding around on horseback seeing after the stock is an enjoyable exercise, when the heat is not too intense; but in winter, when the thermometer is ten degrees below zero, and a keen wind blowing, it is an unpleasant task.

In reference to raising horses the labor is not so great, as they are shifted from place to place more easily and stand the winters better. They, too, have to be "rounded up" occasionally, in order to brand the colts and to "break in," to lead or ride, or to harness, as may be required. Experienced men are usually entrusted with this task.

The horses are hardy and surefooted, being able to climb almost anywhere a man can go. From the foregoing notes it will be seen that wealth in the Pacific Province is not secured without a good deal of unpleasant work. In Kamloops and kindred towns the people are only beginning to enjoy the comforts and luxuries, derivable only through companionship and co-operative administration to each other's enjoyment, such as people enjoy to a large degree in the older provinces.

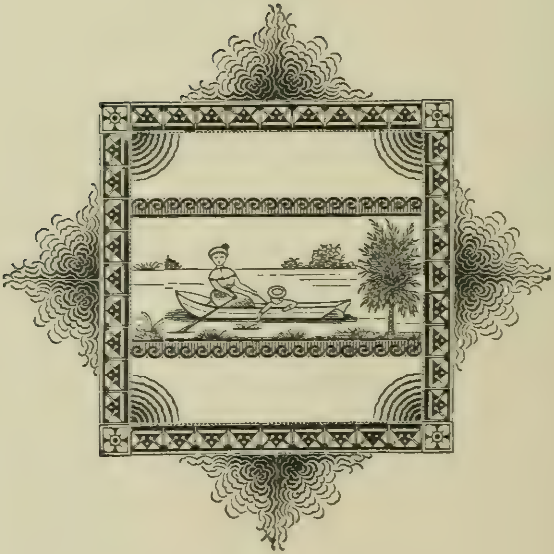
The foregoing is a rough outline of life in British Columbia. One element which has been introduced in the Kamloops District within the last few years, and which has a favorable influence on the morals and finer sentiments, is that of ladies. In the town of Kamloops four years ago there were only some two or three white ladies; now the Town compares favorably with any other of our Eastern towns in this respect, so that in any of the public entertainments or places of worship the fair sex are quite fairly represented. But since I propose to state something on the subject of irrigation, I must drop this phase of life in British Columbia.

So far I have only mentioned the country in its connection with stock-raising and the methods pursued with regard to that enterprise. I will now notice its agricultural resources. To the uninitiated who land in the country in the latter part of summer, when vegetation has become more or less dried up, the country would appear absolutely useless for agricultural purposes. The soil has a light sandy appearance in many places, but upon closer examination it will often be found rich in the mineral elements which are utilized in the growth of crops. While in British Columbia I have had to change my opinion previously formed in regard to soils. I have seen abundant crops of grain, grass and roots growing on land which, previous to my experience in this line in British Columbia, I would have pronounced a barren sand and incapable of producing a crop; and this with no fertilizer except being irrigated with an abundant supply of water. I may here add that it is my firm conviction that every acre of land in our Great North-West can be made to produce magnificent crops; but in order to accomplish this, those parts lying between Regina and the Rocky Mountains will have to be supplied with water with which to irrigate the soil when necessary. The practice of irrigating the soil in our country has not received the attention which it deserves. Although in Ontario, we have as a usual thing natural irrigation sufficient to produce a fairly good crop, yet there is scarcely a season when the same could not be increased about one-third if a certain amount of artificial irrigation could be managed. And then, every few years, there comes a dry season in which there is only about one-third of a crop, and this in localities where irrigation could be accomplished at a reasonable outlay, and would be readily undertaken were the practice properly understood. Irrigation, although not much understood in this part of Canada, was practised by the Egyptians, Arabians, Assyrians, Babylonians and Chinese. One valley in Arabia was watered from a vast reservoir made by a dam two miles long and one hundred and twenty feet high, built of enormous blocks of hewn stone, and which stood and restrained the current of a large stream, having seventy tributaries, for some two thousand years. France, Spain and Italy pay great attention to irrigation. The Romans during several centuries constructed expensive works which are still in use. In some parts of these countries all the water in the Lakes and rivers is claimed by the Government, and the people are charged a rental for the water, according to the quantity required during the season, the Government constructing and maintaining the irrigation works. On the American Continent the ancient inhabitants of Peru were found by their conquerors in the use of the most costly works, constructed for the irrigating of their lands. Prescott says, "canals and aqueducts were seen crossing the low lands in all directions and spreading over the whole country like a vast network, diffusing fertility and beauty around them." The Aztecs of Mexico also made use of similar means to counteract the natural dryness of their atmosphere. When the Mormons first settled in Utah in 1846, that Territory was a waste of barren land and sage brush. In 1868, twenty-two years later, there were ninety-three thousand eight hundred acres under irrigation at an expense of $250,000, and since then the area has been very much increased, so that we have a case here in which the desert has been made "to blossom as the rose," by the simple art of irrigation. In Colorado extensive canals and other improvements have been constructed at a large cost, and over a million acres thus brought under cultivation. In that State the water is controlled by joint stock companies, and delivered to the farmers at a cost of from a dollar to two dollars per square inch equal to about a dollar per acre, the cost of distribution over the land itself being about one half dollar per acre. A fall of three feet per mile will give a velocity of about three miles per hour, and one square inch having this velocity is considered sufficient for each acre under cultivation. In any country if the cross section of the stream, which may be used to irrigate the land, be determined, the number of inches may be taken as a practical measure of the number of acres, which can be irrigated if all the the water should be used for that purpose. For example, a stream of 100 feet wide and 5 feet deep would water 72,000 acres or 720 farms of 100 acres each. A farmer with 100 acres of land under cultivation secures 100 inches of water at this velocity, and he can with it water his whole crop in ten or twelve days. Wheat usually requires to be watered two or three times during the season, late crops needing it much oftener. In California the system of irrigation is carried on in very much the same way as in British Columbia, each farmer constructing his own ditches which are often rude affairs, but nevertheless they succeed in bringing the water, in some cases, ten miles. There are a few companies which supply water on the same system as in Colorado, while numerous farms, gardens and orchards are irrigated by small ditches and wells. Many complications have arisen in California over this water question, regarding individual and prior rights, and it bids fair to become the cause of a great deal of litigation in our own Province of British Columbia. In that Province at present but a small proportion of the land which might be utilized in this way is brought under cultivation. In not a few cases persons who are in possession of irrigable lands through which streams pass have already had registered to their credit more water than is found running in the streams after the flood once passes away in the Spring. The only remedy which I can see would be to construct dams and form reservoirs at the sources of these streams, or in some other suitable place, and retain all the water which accumulates from melting snows. In British Columbia the valleys are surrounded by mountains to such an extent, that there would be a supply of water from the snow melted from off them quite sufficient to irrigate all the land that could be brought under cultivation, were it only preserved in reservoirs for summer use. This, however, would require considerable capital. One of the difficulties with which any company would have to contend, in adopting a system of irrigation for British Columbia, would be settling with owners of private rights. People who own rights of this kind are generally disposed to take every advantage afforded by such rights. A person would naturally think, that if those who possess registered rights in certain streams had their usual supply delivered at their farms free of cost by a company, that this would more than compensate them for the right, but such is not the case. Their present possession of the water secures them from competition, which would be the result of other settlements near them, and this is by no means a small consideration to those who own from five hundred to twenty-five hundred head of stock, for which they are naturally anxious to have as wide a pasture range as possible over the Government lands. There are men to-day on the lookout to secure all the water privileges possible, expecting that if they can secure the water they will have the use of large tracts of land unmolested. These men are awake to their own interests. You will find that the people of the Western Province are not slow in looking after their own interests in these as well as other respects. They, as a rule, don't understand that it would be an advantage to the country if it were more densely populated. Business men and manufacturers are alive to this question, but ranchmen don't want to see any alteration in this respect. They are quite satisfied to let matters remain as they are and would discourage any effort which might be made to settle the country or improve it by bringing a larger area under cultivation, except as a means of increasing their winter supply of hay and feed for winter use. In computing the measure of water supply by inches, there are several standards by which this quantity is determined. That generally understood in California is the miner's inch, an arbitrary measurement established many years ago by the miners in accordance with laws which they adopted. It is a quantity of water which is discharged from an opening one inch square through a two inch plank with a pressure of six inches above the opening. Another standard known as the Smartville inch is measured by a four inch orifice under a pressure of seven inches above the upper edge of the opening. An opening four inches wide and two hundred and fifty inches long, with the seven inch pressure above the top of the orifice, discharges 1000 Smartville inches. Each square inch of the opening discharges 1.76 cubic feet per minute, which is nearly the same as the discharge through a two inch orifice in a plank with a pressure of nine inches above the centre of the opening, and which is equal to 1.78 cubic feet per minute. The inch of the Park Canal Company in California discharges 1.39 cubic feet per minute.

In elevations where the pressure of the atmosphere is much less than at or near sea level, we can understand that through an orifice of a given size the discharge would be considerably less than would pass through an orifice of similar size at a lower altitude where the atmospheric pressure would be greater; so that the only correct rule to be adopted in measuring water supply would be let an inch, or whatever is adopted as the unit of measurement, mean a certain definite quantity of water discharged in a certain time. Whether 1.76, 1.78 or 1.36 cubic feet per minute, let the inch be determined in this way, which is the most simple method as well as the most accurate. The cross section of a stream may be determined in square feet or fractions thereof, the velocity of the stream in feet per minute by means of floats, and then if $A =$ area of cross section in feet, $V =$ velocity of steam in feet per minute, then the capacity of a ditch or stream in inches will equal $\frac{A + V}{1.76}$.

But the field is a large one, embracing the construction of ditches and canals with the various methods adapted for conveying water, also the different devices in use for raising it from streams and wells beneath the surface to be irrigated. Then there is the preparation of the surface and means of distributing the water over the entire area of the same, requiring careful attention when the land to be watered is to any extent hilly. Irrigating in itself after the water has been procured is quite an art, and is understood pretty well by many of the Chinamen, who are found at nearly every ranch. Very likely many of these Chinamen learned the art in their native country, and as a rule they take naturally to that kind of work. But my paper is already too long, and I fear will not be sufficiently interesting to be appreciated. The subject is an important one, and I trust it will receive attention from some member who is better qualified to do it justice than I am.

THOMAS FAWCETT.



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MEMORANDUM

PREPARED BY A COMMITTEE APPOINTED AT THE FIFTH ANNUAL MEETING

OF THE

Dominion Land Surveyors Association,

HELD AT OTTAWA, MARCH 15TH AND 16TH, 1888,

TO CONSIDER THE QUESTION OF A

Trigonometrical Survey of the Dominion.

To draft a scheme for its inception, and to take such steps as they might deem advisable, to bring the subject under the notice of the Government and of others likely to be interested in this much needed work.

COMMITTEE.

OTTO J. KLOTZ, D.T.S.
W. F. KING, D.T.S.
W. S. DREWRY, D.L.S.
E. J. RAINBOTH, D.L.S.
J. S. DENNIS, D.T.S.

Montreal:
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1888.

Memorandum.

AT the fifth Annual Meeting of the Association of Dominion Land Surveyors, held at Ottawa, on the 14th and 15th of March last, a Committee was appointed to consider the question of a Trigonometrical Survey of the Dominion, to draft a scheme for its inception, and to take such steps as they might deem advisable to bring the subject under the notice of the Government, and of others likely to be interested in this much needed work.

The Committee beg to submit the following in reference thereto:

The Dominion has now arrived at that stage when the wants of the country demand a more exact system of survey than that in vogue.

The question of the value and utility of a trigonometrical survey has been so settled by almost every civilized nation, that it is hardly necessary to advance proof of the statement that it would be of immense practical value to the whole Dominion; but for illustration, and in support of the statement, the following facts are offered.

The surveys of this kind, which have been made by other countries, may be briefly referred to.

First and foremost is the Ordnance Survey of Great Britain and Ireland, covering nearly 111,000 square miles, which was begun in 1784 and is now nearing completion. Then comes the great Trigonometrical Survey of India, inaugurated at the beginning of the present century by Colonel Lambton, which is still in progress, and of which the beneficial results have been inestimable. Belgium is carrying on a survey which, when completed, will furnish 450 sheets of map on a scale of $\frac{1}{20,000}$ with contour lines one metre apart.

Prussia is carrying on an extensive survey, and since 1849 has introduced new and more perfect methods. Russia, with its enormous territory, about twice the size of the United States, including Alaska, has been for many years engaged in prosecuting trigonometrical surveys.

Norway, although a comparatively poor country, has set itself on having a good topographical map, on a scale of $\frac{1}{10,000}$ compiled from trigonometrical surveys.

Austria has completed a new map of the Empire, comprising 715 sheets also compiled from data furnished by trigonometrical surveys.

Denmark, Switzerland, Spain, Portugal and Italy are all carrying on trigonometrical surveys, to enable them to map their territories accurately.

France has completed her survey, and the result is shown in 276 sheets of map.

On this continent surveys of a high order of precision have been made by the United States Government, and the work of the Coast and Geodetic Survey is going steadily on, having been extended along the sea coast and also along the Great Lakes, and many of the States and Territories have been covered by its operations, including some in the far West, viz.: Nevada, Colorado, Utah, New Mexico, Montana, Idaho and part of Arizona.

Several of the states have conducted independent trigonometrical surveys of their own territory, including Massachusetts, California, New Jersey and New Hampshire, and in other states they are in progress.

All the foregoing surveys are based on triangulation.

It may be asked what are the practical benefits to be derived from a trigonometrical survey, and what is there to justify the expenditure of the large sum of money which a survey of this kind would ultimately cost. To make the point of practical benefit clear, the following will be readily understood by all:

It is stated by an eminent American Engineer that "if the State of Massachusetts had had a good topographical map in 1836, some $20,000,000 would probably have been saved in its public railway expenditure."

Mr. Sandford Fleming, C.M.G., in his report to the Minister of Public Works, dated April 5th, 1879, says: "If the railways of Ontario had to be established 'de novo,' a careful study of the requirements of that Province would enable any intelligent engineer of ordinary experience to project a new system which at one half the cost would far better serve the public, and would meet every demand of traffic, would more fully satisfy every expectation, and which would not result in disappointment and loss to those who have been induced to invest their means in that which has proved to many an unprofitable undertaking."

If to-day a railroad is projected in England, or any other country possessed of a good topographical map, preliminary surveys such as we are obliged to make are unnecessary, for from these plans the lengths and grades of any proposed line can be determined with sufficient accuracy to enable a final location to be made.

In carrying on a survey of the character contemplated, it is necessary to run lines of exact levels from station to station, and thus we would have the elevations of points all through the settled portions of the country, and in future operations, in which levelling is a feature, all levels could be referred to a common datum line (sea level for instance), and when railway lines are pushed back into the wooded interior, the physical character of which is but little known, we would then have some definite idea of main watersheds and valleys, to guide future operations, instead of relying, as is at present done, on guess work and hearsay evidence.

Among other benefits to be derived from a survey of this kind, are the following: Our extensive coast line both in the Gulf of St. Lawrence, on the Atlantic and Pacific seaboards, and also in our inland waters, has been very roughly determined in many places, and in consequence many disasters happen to shipping, and many valuable lives are lost annually, which would in a great measure be avoided were we in possession of reliable charts of our waters; and one of the first requisites in making the hydrographic surveys, necessary to provide the data or compilation of these charts, is that certain points on the shore should be accurately fixed. It may be mentioned in connection with the Hydrographic Survey of Georgian Bay, at present being carried on under the direction of Staff Commander Boulton, R.N., that Commander Boulton stated before the D. L. S. Association, at its last annual meeting, that in making his survey he had not been able to connect his work with any point accurately determined by Canadian authority, but had to use points established by the United States Coast and Geodetic Survey.

On our inland lakes and waters large sums are annually spent in harbor and other improvements, and yet the geographical positions of these harbors and waters are not accurately shown on any map or chart.

A large sum has been spent in building the Murray Canal between Lake Ontario and the Bay of Quinte, but there is no correct chart of the Bay, and a stranger attempting to navigate a deeply laden vessel in its waters would probably meet with disaster. This has happened time and again, and will continue until we have an accurate chart of the Bay, and as has already been said the work of making these charts would be greatly expedited by having points along the shores established by a trigonometrical survey from which to begin the hydrographic survey.

Numerous isolated surveys have been made under various departments of the Government, at points on the Atlantic coast, the Gulf of St. Lawrence, and in the Great Lakes; it is also proposed by the Militia Department to make a series of reconnaissance surveys at different points; all these surveys, made, or to be made, give valuable results, but they cannot be considered complete until they are connected. To this end a carefully executed triangulation is necessary.

Again, with the increase in the value of real property, any work having in view the permanent marking of points which would definitely fix the positions of boundaries of real estate, is for the public good. In many of the Provinces the boundaries of valuable properties are in most cases dependent on the durability of wooden posts, a few marks on trees, or the testimony of a few of the oldest inhabitants, and as a consequence expensive litigation often arises, in fact it may safely be said that the amount annually expended in litigation regarding boundaries would go a long way towards paying for the cost of a trigonometrical survey.

Were the boundaries, especially those of large areas, such as counties, townships, and concessions, accurately defined by a trigonometrical survey, similar to that made by the countries herein referred to, all doubt as to their position would be forever set at rest.

At the present time, throughout the Dominion, every city and many of the towns and villages are looking about for means of obtaining a good water supply or of improving the supply they have.

Gravity being the best method of utilizing a water supply, is generally first sought after, but the information necessary to determine the availability of a supply by this means, can now only be had by expenditure of large sums in surveys, as has been lately seen in Toronto.

Had there been a good topographical map in existence, that expenditure would have been unnecessary.

In drainage work the information derivable from a survey of this kind would be invaluable, and as our agricultural population is waking up to the benefits arising from proper drainage, no time should be lost in giving them this aid. The maps would enable any engineer to determine by a simple calculation the area of any basin to be drained, and to know accurately the size of drain necessary, and its proper location, and the survey would do away with all litigation arising from parties claiming that their lands do not lie in the basin to be drained, as a reference to the map would show at a glance the natural drainage outlet for any piece of land.

These maps would also be exceedingly valuable in assisting an equitable assessment of real estate for taxes, and in providing the necessary information required in locating and building public highways, and would save large sums of money which are now expended in finding out where roads should be built; and the sum so saved might be expended in making the roads more solid and permanent.

The information afforded by the maps provided from a survey of this kind, in reference to our inland waters, and the possibility of their utilization for navigation which is becomng every day of more importance, would be of vast benefit to the country.

Many large public works are now being agitated, and will no doubt in the near future be undertaken, as, for instance, the "Ottawa Ship Canal," the "Trent Valley Canal," etc., the possession of good topographical maps would very naturally assist in settling the question of the feasibility of these and many other schemes for the improvement of navigation, etc.

Instances might be cited indefinitely to prove the value, not only to the Government, but to the people at large of a trigonometrical and accompanying detail survey of the kind herein referred to, but it is thought that enough has been said to conclusively show the benefits which would accrue therefrom.

The survey should be undertaken by the Federal Government, as it is pre-eminently a Dominion work, and we now come to the important point of a basis or scheme for its inception.

In a work of such proportions as a survey of this kind would alternately assume, it is primarily essential that a well matured and carefully considered scheme be first laid down, upon which to develop the whole; and being guided by the experience of other countries, it is evident that a primary triangulation is necessary as a ground work for all detail surveys.

For the inception of the work, and that a beginning may be made, it is suggested that the work should be commenced on the St. Lawrence River near Cornwall, where the U. S. Lake survey ended, and be continued down that River to the Gulf. The work would first consist of a primary triangulation, with sides of from 10 to 30 miles in length, as circumstances permitted, and would then be extended by carrying on a greater or less amount of interior topographical work, levelling, etc.

COST.

The cost would of course vary with the extent of survey, but it is thought that a sum of, say, $15,000 would be sufficient to start the primary triangulation, which is the basis of survey. This amount would cover the cost of two observers, one on each side of a main chain of triangulation, and two station setting parties, and would pay all expenditure of the above for transport and travelling expenses.

Of course a much larger sum than that mentioned could be advantageously employed, but the annual expenditure of this small amount would provide a large quantity of valuable information, and would lay the foundation for more extensive prosecution of the work, when the circumstances warranted it.

The advantages accruing to the country by a geodetic survey would not be confined to the definite material advantages gained in topographical knowledge, and the coast and sounding surveys based upon the triangulation.

An additional and not inconsiderable advantage would be the stimulus given to scientific research. It has been the experience of other countries that men employed on geodetic surveys, having their attention drawn to the numerous branches of science involved, have, by their scientific and mechanical inventions, added greatly to the sum of knowledge in these branches, and indirectly to the material wealth and progress of the countries.

The Association of Dominion Land Surveyors has long felt that the time had arrived when a trigonometrical survey of the country should be begun, and the question has frequently been discussed at their annual meetings. In 1886 they took action in the matter by preparing a memorial on the subject, and submitted the same to the Hon. the Minister of the Interior; and recognizing the necessity for keeping the matter alive, they appointed this committee, as has already been mentioned, to prepare a memorandum on the subject.

In submitting this memorandum for your consideration, the committee feel that the subject is one which should appeal strongly to all who are interested in the welfare of our Dominion, and they think the facts herein contained should be sufficient to show the necessity for a beginning being made towards a geodetic survey of our country.

They earnestly ask you to do anything you can to assist the Association in bringing this matter to the notice of any who are likely to be interested in seeing this much needed work begun, all of which is respectfully submitted.

W. F. KING,
O. J. KLOTZ,
W. S. DREWRY, } Committee
E. J. RAINBOTH
J. S. DENNIS.

OTTAWA, April 13th, 1888.

MEMORANDUM,

PREPARED BY THE EXECUTIVE COMMITTEE

OF THE

Dominion Land Surveyors Association,

IN ACCORDANCE WITH A RESOLUTION REGARDING

GEOGRAPHICAL * NOMENCLATURE * AND * ORTHOGRAPHY

IN

CANADA.

Passed at the Annual Meeting, held at Ottawa, March
15th and 16th, 1888.

Montreal:
PRINTED BY JOHN LOVELL & SON.
1888.

MEMORANDUM.

In accordance with a resolution regarding the naming of geographical features, passed at the last annual meeting of the Association of Dominion Land Surveyors, the Executive Committee beg to submit the following remarks in reference to the important question of geographical nomenclature and orthography in Canada, and to make certain suggestions regarding the necessary action to correct many of the mistakes and inconsistencies now existing, and to prevent re-occurrence of the same in the future.

The Committee having invited the views of those gentlemen connected with the Government service, who have to do with the naming of geographical features, or the compilation of Government maps, and who are, therefore, in a position to speak intelligently on this point, submit the same as affording most valuable and reliable information in reference thereto.

SUGGESTIONS ON GEOGRAPHICAL NOMENCLATURE IN CANADA.

BY DR. G. M. DAWSON, GEOLOGICAL SURVEY.

" So far as I have been able to discover, no code of rules bear-
" ing on the introduction or use of geographical names in new or
" unmapped country has been authoritatively formulated or con-
" sistently followed. Usage in the matter has been very varied,
" and often quite manifestly very absurd and unjust, both toward
" the native races inhabiting such new countries and to the earlier
" civilized explorers, the names given by whom have too often been
" ignored in consequence of the egotism, ignorance or in some
" cases the sycophancy of later explorers or surveyors. The very
" intricacies of the question and the diversity of circumstances in
" different regions appear to have constituted the chief difficulty
" met with in laying down uniform rules, but it seems that it may
" not be impossible to formulate principles which should be appli-
" cable to the circumstances in so far as the Dominion of Canada

" is concerned. The matter is an important one from a practical " point of view alone, and the fixing of geographical names in the " first instance on published maps carries with it a considerable " responsibility.

" Dr. Egli, from a study of known geographical names, enun- " ciates the following law as the result of his investigations :—

" ' Geographical onamotology, regarded as the intellectual out- " come of a people or of an epoch, represents both the stage " and direction of culture specially characteristic of that onamo- " tological family.' (*Nomina Geographica Leipsic* 1870–73, *quoted in Scottish Geog. Mag., Vol. I., p.* 425.)

" Respecting the orthography of geographical names, however, " some progress has been made, and principles have been recom- " mended which it may be well to follow. The Royal Geographi- " cal Society has adopted (in 1885) a series of rules of which the " essential points, in so far as they are applicable to the particular " question under discussion, may be summarized as follows :

(Journal Royal Geog. Society, Vol. VII, p. 535.*)*

" ' Names which have passed into common usage, whether " correctly rendered or otherwise, should be retained.

" ' Names, such as native names, which have not been committed " to writing in characters of the Roman alphabet, to be spelt " according to sound as nearly as possible.'

" For this purpose definite values are assigned to the letters of " the alphabet, the main features of the alphabet recommended " being as follows :—' Vowels to be pronounced as in Italian, " consonants as in English. An acute accent to mark the sylla- " ble on which stress is laid in pronunciation.'

" The Geographical Society of Paris, about a year later, adopted " rules for orthography which are practically identical with the " above. The alphabets recommended by both societies are also " nearly the same with Gibb's standard alphabet published by the " Smithsonian Institution in 1863, and with that of Major J. W. " Powell (1880), the two last being, however, intended for linguis- " tic purposes. Though any one of these alphabets might be " employed with advantage, I believe that the preference should be " given to the first mentioned, as having been adopted from a " specially geographical standpoint, as being that likely to be " employed for scientific geography in the numerous and widely

" scattered regions constituting this Empire, and as being sufficiently precise for the purpose in view, while at the same time " simple.

" In cases of conflicting names applied to the same feature, and " for guidance in selecting those to be definitely perpetuated on " official maps, the underlying rule must, I think, be that of priority. This rule has always been tacitly recognized in geography, " it has been affirmed lately by the Geological Congress, and has " been generally acknowledged in systematic scientific nomenclature. Without entering into a statement of the obvious advantages of such a principle, I may quote the following remarks as " embodying a late pronouncement in its favor from the *Code of* " *Nomenclature and Check List of North American Birds* (1886). " The passage quoted is of course intended to apply specially to " scientific nomenclature in Natural History, but is in most points " equally applicable to the systematic nomenclature of natural " features. 'The general tendency at present is in favor of the " greatest attainable fixity of names, by the most rigid adherence " to the law of priority under all practicable circumstances, and " by the disregard as far as possible of all rules requiring the " rejection of names for faulty construction, for barbarity, for " being meaningless, and even for being literally false.'

" With the facts above referred to in view, and taking also into " account the other considerations which affect the question, I " venture to suggest the following as principles to be observed in " regard to the nomenclature of plans in Canada:

" 1. Names of places should be adopted and perpetuated as " they occur where first published on maps or in reports or works " in which the places are described.

" Provided, however, that the mere incidental mention of names " which cannot certainly be localized, or which it may be evident " have been carelessly or casually referred to, may be rejected or " modified.

" Exceptions to this rule may also occasionally and guardedly " be allowed in the case of names which may have become entirely " obsolete, owing to insufficient publication.

" 2. Where well recognized English and French equivalents " exist for the names of places, either form may be employed, but " so far as possible that first given to any place should be retained " in its original form; and where reports or works are translated " from English to French, or conversely, the names of places should " not be changed except in the case first mentioned.

“ 3. In respect to geographical featutes for which no published
“ names exist, the names employed by the natives of the district
“ should be assumed to have priority.

“ Exceptions may be made to this rule where traders, settlers,
“ miners, etc., have applied names which have become locally
“ known in place of the native names. Also where the native
“ names are too long or too difficult of pronunciation for conve-
“ nient use, and where the same names have already been applied
“ to places in the same or neighboring districts, and are thus
“ likely to lead to confusion, though the duplication of names of
“ minor features in widely separated localities cannot in all cases
“ be avoided, and where they are not likely to appear together
“ on general maps is scarcely objectionable.

“ In the case of the exceptions noted in the above paragraph,
“ the translations of Indian names may often be adopted with
“ advantage.

“ 4. When native names are adopted according to the above
“ rule, they should be taken in their entirety, and not arbitrarily
“ mutilated or cut down for the sake of brevity, though the general
“ term denoting river, lake, etc., may be dropped—e.g. *wapta*
“ (Stoney), *sipsi* (Cree) meaning river, *sagohequn* (Cree) meaning
“ lake, etc.

“ 5. All such native names for the first time published to be
“ spelt according to sound, in conformity with the alphabet recom-
“ mended by the Royal Geographical Society.

“ 6. In all cases where after due enquiry it is found necessary
“ to apply new names, either owing to the non-existence of
“ recognized names or to inability to ascertain the native names,
“ they should be whenever possible of a descriptive character or
“ have some historical or other potent connection with the district,
“ all trivial, meaningless or too common names being carefully
“ avoided.

“ 7. All names of places in newly explored or surveyed districts
“ to be approved before publication by the Surveyor General, the
“ Director of the Geological Survey, or head of any other Depart-
“ ment, under which original geographical work may be carried
“ out; it being understood that the head of such Department
“ assumes the responsibility of the nomenclature and of the ortho-
“ graphy of names.

EXTRACT FROM LETTER OF THE SURVEYOR GENERAL, DATED 3RD APRIL (INSTANT.)

"In reply I beg to say that this subject was already discussed "between Dr. Dawson and myself, and that I concur in the views "which he expressed and which he has, I presume, already sub-"mitted to the Association. I will merely add a few remarks.

"In the first place, I believe that the privilege of giving names "should be used as sparingly as possible. Whenever it is possible "to ascertain the name used by the inhabitants of the country or "given by former explorers, it should be preserved, unless it be "such as to create confusion, in which case it should be either "slightly altered or changed altogether.

"In the next place, I am of opinion that except in the case of "unpronouncable Indian names, translations should not be "made. This should be an absolute rule for personal names. I "might cite instances in which the non-observance of this rule "has been the cause of confusion and ludicrous mistakes.

"When a name has to be given, I think that it should be one "suggested by the natural features of the ground or surrounding "country, in preference to any other; where no peculiarity exists, "then the name of some distinguished person or remarkable occur-"rence, this to be left to the judgment of the explorer.

EXTRACT FROM LETTER OF STAFF COMMANDER BOULTON, R.N., DATED MARCH 26TH (INSTANT).

"I have the honor to submit the following:

"1. That there should be a Government Officer from whom "Surveyors could ascertain if the geographical feature they are "about to name *already possesses one.*

"2. This curator should possess a copy of every Federal and "Provincial Government map or chart, should have a good "knowledge of French and the Indian languages, so that he may "be an *authority* for the correct orthography of any names "surveyors may give or report in their maps or charts.

"3. That when Indian names are given, the syllabic system by "hyphens should be adhered to as "Ma-ni-to-wa-ning."

"4. That when native names are given, the English translations "should be bracketted in alongside of them, if there is room.

"5. When Indian names are considered to be too long for "practical use, their English equivalents should be used instead.

"I append hereto for the consideration of the Association a "system of orthography issued by the Admiralty for the guidance "of Admiralty Surveyors abroad :—

SYSTEM OF ORTHOGRAPHY.

1. All geographical names in countries which use the Roman character should be spelt as by the respective nations, or as generally recognized by Englishmen. In some cases both forms may be necessary, thus, Livorno (Leghorn).

2. Names in countries which do not use the Roman character are to be spelt after the following system, except in such cases as by long usage have become familiar to English eyes, thus Calcutta, Cutch, Celebes, Mecca, and similar words, should be written as heretofore.

3. The true sound of the word as locally pronounced will be taken as the basis of the spelling.

4. An approximation of the sound is alone aimed at. A system which would attempt to represent the more delicate inflections of sound and accent would be so complicated as only to defeat itself

5. The broad features of the system adopted are that vowels are pronounced as in Italian and consonants as in English.

6. One accent only is used, the acute, to denote the syllable on, which stress is laid. This is very important, as the sounds of many names are entirely altered by the misplacement of this "stress."

7. Every letter is pronounced. When two vowels come together each one is sounded, though the result, when spoken quickly, is sometimes scarcely to be distinguished from a single sound, as in *ai*, *au*, *ei*.

The amplification of the rules is given below :—

Letters.	Pronunciation and Remarks.	Examples.
a	*ah*, *a* as in *father*	Java, Banána, Somáli, Bari,
e	*eh*, *e* as in *benefit*	Tel-el-Kebír, Oléleh, Yezo, Levúka, Peru.
i	English *e*; *i* as in *ravine*; the sound of *ee* in *beet* . Thus, not *Feejee*, but	Fiji, Hindi.
o	*o* as in *mote*	Tokio.
u	long *u* as in *flute*; the sound of *oo* in *boot*. *oo* or *ou* should never be employed for this sound. Thus, not *Zooloo* or *Zoulou*, but	Zulu, Sumatra.
	All vowels are shortened in sound by doubling the following consonant.	Yarra, Tanna, Mecca, Jidda, Bonny.
	Doubling of a vowel is only necessary where there is a distinct repetition of the single sound.	Nuulúa.

Letters.	Pronunciation and Remarks.	Examples.
ai	English *i* as in *ice*	Shanghai.
au	*ow* as in *hou* . Thus, not *Foochow*, but	Fuchau.
ao	is slightly different from above .	Macao.
ei	is the sound of the two Italian vowels, but is frequently slurred over, when it is scarcely to be distinguished from *ey* in the English *they*.	Beirût, Beillû.
b	English *b*.	
c	is always soft, but is so nearly the sound of *s* that it eshould b seldom used. If *Celebes* were not already recognized it would be written *Selebes*.	Celebes.
ch	is always soft as in *church* . .	Chingchin.
d	English *d*.	
f	English *f*. *ph* should not be used for the sound of *f*. . Thus, not *Haiphong*, but	Haifong, Nafa.
g	is always hard. (Soft *g* is given by *j*)	Galâpagos.
h	is always pronounced when inserted.	
j	English *j*. *Dj* should never be put for this sound.	Japan, Jinchuen.
k	English *k*. It should always be put for the hard *c*. . Thus, not *Corea*, but	Korea.
kh	The Oriental guttural	Khan.
gh	is another guttural, as in the Turkish	Dagh, Ghazi.
l m n	As in English.	
ng	has two separate sounds, the one hard as in the English word *finger*, the other as in *singer*. As these two sounds are rarely employed in the same locality, no attempt is made to distinguish between them.	
p	As in English.	
q	should never be employed ; *qu* is given as *kw*	Kwangtung.
r s t v w x	As in English.	Sawâkin.
y	is always a consonant, as in *yard*, and therefore should never be used as a terminal, *i* or *e* being substituted, Thus, not *Mikindány*, but not *Kwaly*, but	Kikuyu. Mikindâni. Kwale.
z	English *z*	Zulu.
	Accents should not generally be used, but where there is a very decided emphatic syllable or stress, which affects the sound of the word, it should be marked by an *acute* accent.	Tongatâbu, Galâpagos, Palâwan, Sarâwak.

EXTRACTS REFERRING TO NOMENCLATURE OF GEOGRAPHICAL FEATURES, FROM ADMIRALTY GENERAL INSTRUCTIONS FOR HYDROGRAPHICAL SURVEYORS, 1888, p. 16.

"The surveyor should therefore take every pains to ascertain the acknowledged or native names. * * * Where such acknowledged names cannot be obtained, then let the surveyor freely give as many as will answer the purpose, but he should avoid the silly repetition of popular names, which so much tends to confuse our gazetteers and to perplex our memories. *He should beware of meddling with names already established;* these which have been stamped upon places by the first discoverer are held sacred by the common consent of all nations, and when new ones must be given it would show better taste to make the name convey some idea of the form or character or productions of the place, or some characteristic of its inhabitants, than to exhaust the catalogues of public characters or private friends. The officers and crews, indeed, may have some claim to such a distinction, which, slight as it is, help to excite additional interest in a laborious exploring voyage."

EXTRACT FROM LETTER OF PROFESSOR MACOUN, GEOLOGICAL SURVEY, DATED APRIL 12TH (INSTANT.)

"My work for the last four years has been an examination into "the geographical distribution of our vegetable productions, and "this has led me to use nearly all the geographical names in the "country. As time passed, I began to see the utter confusion "that existed in the spelling of the various geographical names, "and the evident misapprehension of the origin of many of them.

"Many places in Quebec and the Northwest have become half "English and half French, as River du Loup, River de Brig, and "even Cape d'Espoir, on the Bay of Chaleurs, has become Cape "Despair; you may imagine how foolish I looked when I said to a "gentleman as we passed along it on a calm day, that it was well "named Despair, for there would be no hope for any vessel forced "upon the cliffs. The answer was: 'You are wrong regarding "the name, as it means the Cape of Hope, not the Cape Despair, "as you seem to think.'

"In conversation with the French translators at the House, I "find they are troubled over this putting an English *dress* on a "French *form*, which there is no warrant for except our loose "habit of writing what we think, and ignoring authority.

"Taking this view of the matter, I would recommend that your "Committee press upon the Surveyor General the necessity of "adopting at once some uniform method of spelling the old

" geographical names of every part of Canada, and would suggest " that he go back to the first authoritative map of the country for " the spelling. In doing this it would be very easy to make out " a complete Geographical Dictionary of the whole Dominion, and " we would have spelling and derivation in a most valuable form.

" Sooner or later, this will have to be done, and it is probable a " person could be found who would undertake the task for the love " of the work."

Very little need be added by the Committee to the remarks of the gentlemen submitted herewith, but for illustration and to show clearly the necessity for action in this matter, the following instances of erroneous naming of points and letter to the *Montreal Witness* may be of interest :

EXTRACT FROM A MEMORANDUM OF MR. R. H. HUNTER, DATED 6TH APRIL (INSTANT).

" St. Clements Point, Lake Winnipeg. On this point is situated " the small hut of a fur trader, named Jack Clements, a native of " Michigan ; in consequence of his residence there during the past " few years, the point has become known to the frequenters of the " Lake as Clement's Point. Up to date, Mr. Clements has not " become canonized.

" Fort St. Frances, Rainy River District. This post of the " Hudson's Bay Company was named Fort Frances nearly sixty " years, in honor of Lady Frances Simpson, the wife of the Gov- " ernor of the H. B. Co. Although Lady Simpson was a devout ' Christian and highly esteemed and beloved by all who had the " honor of her acquaintance, yet there is no record of her being " canonized.

" Lake St. Joseph, Albany River District. Although this Lake is " so named on the maps of the Department of the Interior and the " Department of Railways and Canals, the name is entirely un- " known to the residents of the district ; it is known by them as " Lake Albany, and sometimes as the Big Lake Albany, in contra- " distinction to a small lake of the same name, some hundred miles " or so to the Northwest. It is true that the Lake has been known " to the French Canadian fur traders, or " coureurs de bois," as " Lac Joseph, but these traders never called it Lac St. Joseph.

" Blood River, east side of Lake Winnipeg. This should be " Bloodvein River, the former name being unknown to the resi- " dents of the vicinity. The name is given the river on account of " the red veins running or intermixed in the granite formation " through which the river runs.

"On some of the Government maps a portion of the Lake of "the Woods is improperly called Clear Water Lake, this name is "quite unknown to the residents and natives of that section; the "name has evidently been introduced by some surveyor or "draughtsman."

DUPLICATION OF NAMES, LETTER TO MONTREAL WITNESS.

"SIR,

"Your reference in a recent issue to the duplication of the names "of places raises a very important question. It seems to me that, "at least in the Northwest, the names of all important physical "features in the country, as rivers, mountains, lakes, bays, etc., "should be in the hands of the Surveyor General at Ottawa, so as "to avoid duplication. The matter, I understand, has been brought "before the attention of the Minister of the Interior, with a view of "having duplication remedied there before the country becomes "more settled, and before these duplicate names creep into hundreds of deeds, books, reports, etc., when change will be exceedingly difficult. Our own Northwest is not the model in respect "of duplication which you think it is. At present, we have four "Saskatchewan Rivers, including the North Branch, the South "Branch, the Little Saskatchewan at Minnedosa, and the Little "Saskatchewan, between Lakes Manitoba and Winnipeg. In the "works of Hooker, Richardson and others, it is often impossible "to ascertain whether the north or the south branch of the Saskatchewan is intended, and yet these two streams are 140 miles "apart. There are two large Red Deer Rivers, one flowing into "Lake Winnipegoosis, the other into the South Saskatchewan "There are two important Pembina Rivers, one in Manitoba, the "other near Edmonton, but a tributary of the River Athabaska. "There is a large Shoal Lake near Winnipeg and a smaller but "better known Shoal Lake near Birtle. Lakes and rivers named "after birds and other animals, as Swan, Heron, Pelican, Rat "Beaver, etc., are repeated in some cases several times. I have "never been able to see why the Indian names, where sufficiently "euphonious and appropriate, have not been retained. As the "surveys annually made by the Department of the Interior and "Geological Survey progress, new or little known lakes, rivers, etc., "are being constantly outlined, and, in such cases, there should be "no difficulty in giving appropriate names.

"In the older settled districts it is possible that an act of Parliament might be required to make changes.

A. T. D."

The subject is one which has no doubt received more or less attention from all persons engaged in any way in compiling maps or dealing with geographical names, and all must have noticed the many errors and inconsistencies that exist in our geographical nomenclature.

The Committee suggest the following scheme for adoption by the Government, to correct the many errors now existing and to prevent their re-occurrence:—

1. That some Officer of the Government be charged with the duty of collecting all the information necessary to enable him to compile a complete Geographical Dictionary of the Dominion, somewhat after the same style as that compiled for the Province of Quebec, by the late Surveyor General Bouchette of Quebec, published in 1832; and that all names as given by this Dictionary be officially confirmed, and the Dictionary thus become an authentic book of reference.

2. That it would be well that this Dictionary cover the whole Dominion, but if it be considered objectionable that the Department of Interior revise names at present existing in the older Provinces, then at least the maps of Manitoba, the Northwest Territories and British Columbia, and all sparsely settled districts generally should come under revision.

3. That special care should be taken to avoid duplication of names. Where several rivers, lakes or other natural features have the same name, and where the question of priority cannot be decided, the difficulty should be avoided by the use of synonyms in different languages—e.g., Red Deer, Elk, Wapiti, &c.; Saskatchewan Rapid, Rolling, Swift, &c.

4. That the Surveyor General, being in the opinion of the Committee the proper person, be charged with the duty of compiling this Dictionary.

5. That all names given by explorers in new tracts of country be submitted to the Surveyor General, and after approval by him be entered in the Geographical Dictionary before being shown on any maps or plans issued by the Government.

6. That the system of nomenclature and orthography suggested by Dr. Dawson, the Surveyor General, Captain Boulton and others as herein quoted, be followed as nearly as possible, and to further this end a memorandum of instructions should be issued by the Surveyor General for the guidance of all persons conducting explorations in new or unknown districts, and who may be called upon to give names to geographical features met with by them.

It may be pointed out that the only branches of the Government service that are engaged in conducting Geographical explorations in unknown portions of the Dominion are the survey branch of the Department of the Interior and the Geological Survey, both of which are under the control and direction of the Hon. the Minister of the Interior ; and also that all the maps or plans of Manitoba, the Northwest Territories and parts of British Columbia are prepared under his direction, it would therefore, be possible for him to take such action as would give immediate effect in a large measure to the suggestions herein contained.

Signed on behalf of the Committee,

E. J. RAINBOTH,
President.

REPORT OF PROCEEDINGS

OF THE

ASSOCIATION OF DOMINION LAND SURVEYORS

AT ITS

SIXTH ANNUAL MEETING,

HELD AT

OTTAWA, FEBRUARY 19, 20 AND 21, 1889.

PRICE FIFTY CENTS

Montreal:
PRINTED FOR THE ASSOCIATION BY JOHN LOVELL & SON.
1889.

To Dominion Land Surveyors.

SHOULD you not be a member of the Association, it is respectfully urged that you at once become such, and by your earnest co-operation assist in making it a means of elevating the standard of the profession, and, by an interchange of ideas, of increasing the scientific knowledge of its members to as great an extent as possible.

Those who are not Dominion Land Surveyors by profession, but whose pursuits, scientific acquirements or practical experience fit them to co-operate with Dominion Land Surveyors in the advancement of professional knowledge, are qualified to join as Associate Members.

Should you be acquainted with any Dominion Land Surveyor who is not a member, or any gentleman qualified to join as an Associate Member, use your earnest endeavours to make him become such. "IN UNITY IS STRENGHT." Then let us unite together, and as a body be one man with one end in view.

"The Welfare of the Profession."

Any Dominion Land Surveyor may become a member of the Association upon payment of dues.

Application blanks for Associate Membership may be obtained from the Secretary-Treasurer.

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ASSOCIATION OF DOMINION LAND SURVEYORS,

Organized April 24th, 1882.

OFFICERS FOR 1889.

HONORARY PRESIDENT.

CAPT. E. DEVILLE, Surveyor General..................Ottawa, Ont.

PRESIDENT.

J. S. DENNIS, D.T.S..............................Ottawa, Ont.

VICE-PRESIDENT.

WM. OGILVIE, D.L.S..............................Gloucester, Ont.

SECRETARY-TREASURER.

ARTHUR O. WHEELER, D.L.S.....................Ottawa, Ont.

EXECUTIVE COMMITTEE.

OTTO J. KLOTZ, D.T.S.........................Preston, Ont.
THOS. FAWCETT, D.T.S.........................Gravenhurst, Ont.
JOHN McLATCHIE, D.L.S.........................New Edinburgh, Ont.

AUDITORS.

J. J. McARTHUR, D.L.S.........................Aylmer, Que.
W. S. DREWEY, D.L.S...........................Belleville, Ont.

STANDING COMMITTEES

FOR 1889.

Instruments.

G. B. ABREY *(Chairman)*, D. C. MORENCY, I. J. DUFRESNE.

Geodetic Surveying.

O. J. KLOTZ *(Chairman)*, JOHN McAREE, GEO. MONTAGU-WHITE.

Publication.

T. D. GREEN *(Chairman)*, C. A. BIGGER, J. A. BELLEAU.

Land Surveying.

JOHN McLATCHIE *(Chairman)*, G. E. McMARTIN, E. BRAY.

Permanent Marking of Surveys.

S. L. BRABAZON *(Chairman)*, P. T. C. DUMAIS, J. H. BROWNLEE.

Natural History and Geology.

PROF. JOHN MACOUN *(Chairman)*, DR. R. BELL, THOS. DRUMMOND.

Topographical Surveying.

W. S. DREWRY *(Chairman)*, J. J. McARTHUR, J. A. KIRK.

CONSTITUTION AND BY-LAWS.

CONSTITUTION.

ARTICLE I.

Name of the Association.

"The Association of Dominion Land Surveyors."

ARTICLE II.

Objects of the Association.

The promotion of the general interests and elevation of the standard of the profession.

ARTICLE III.

Members.

1. The Association shall consist of Active Members, Honorary Members and Associate Members.

2. Active Members must be Dominion Land Surveyors, and only such shall hold office.

3. Any Dominion Land Surveyor may become an active member upon payment of the fees prescribed by Article IX.

4. Honorary Members must be nominated by two Active Members, and the nomination approved by a unanimous vote of the Executive Committee. The nomination with approval must be in the hands of the Secretary-Treasurer at least one month before the Annual Meeting. Persons nominated for Honorary Membership shall submit a Paper to be read at the Annual Meeting. They shall be elected by ballot in the manner hereinafter provided for the

election of officers of the Association. The number of Honorary Members shall not at any one time exceed twenty, and they shall be exempt from payment of dues.

5. (*a*) Associate members shall be those who are not Dominion Land Surveyors by profession, but whose pursuits, scientific acquirements, or practical experience qualify them to co-operate with Dominion Land Surveyors in the advancement of professional knowledge.

(*b*) Provincial Land Surveyors of any Province, and Articled Pupils of Dominion and Provincial Land Surveyors, shall be eligible as Associate Members.

(*c*) Associate Members shall be nominated by one active member in writing to the Secretary-Treasurer, and on approval of such nomination by the Executive Committee shall at once be admitted upon payment of fees prescribed by Article IX.

6. Associate Members shall not vote.

ARTICLE IV.

Officers.

1. The Surveyor General of Dominion Lands shall be Honorary President of the Association.

2. The Officers of the Association shall consist of an Honorary President, a President, Vice-President, Secretary-Treasurer, and an Executive Committee, all of whom, except the Honorary President shall be declared elected at the Annual General Meeting by letter ballot.

3. No member of the Association shall fill the office of President for more than two consecutive years.

4. Nominations for Officers of the Association shall be made to the Secretary-Treasurer in writing by two active members, at least two months before the Annual General Meeting. The Secretary-Treasurer shall prepare and forward ballot papers to the members of the Association, who shall return them marked in sealed envelopes to the Secretary-Treasurer before the date of the Annual General Meeting.

5. The letter ballots shall be opened at the Annual General Meeting, and the majority of the ballots cast in each case shall decide the election.

6. In case of an even or tie vote, the election shall be decided by the members present at the Annual Meeting voting by ballot.

7. Should the Secretary-Treasurer not receive three nominations for each of the offices of President, Vice-President and Secretary-Treasurer, or six nominations for members of the Executive Committee, the Executive Committee shall add to the ballot papers a sufficient number of names, to make up the number of three candidates for each of the offices and twelve for the Executive Committee.

ARTICLE V.

Meetings.

1. The Annual General Meeting shall commence on the third Tuesday in February, at Ottawa.

2 Special Meetings of the Association may be called by the President, or by the President when requested in writing by three or more members.

3. Eleven members shall form a quorum at any meeting for the transaction of business.

ARTICLE VI.

Amendments.

1. Any member of the Association, who may desire a change in the Constitution of the Association, shall give notice of such contemplated change to the Secretary-Treasurer, at least two months before the next Annual General Meeting, and the Secretary-Treasurer shall, in his notice of such meeting to the members, notify them of the name of the party proposing such change, and the nature thereof.

2. No by-law or rule shall be altered, or new one adopted, except at a General Meeting, and such amendment shall be voted upon at the said General Meeting, two-thirds majority of the votes cast being necessary for its adoption.

ARTICLE VII.

Executive Committee.

1. The Executive Committee shall consist of the President, Vice-President, Secretary-Treasurer, and three members; and shall have the direction and management of the affairs of the Association. Three members to form a quorum.

2. The Meetings of the Executive Committee to be held at the call of the President, or Secretary-Treasurer.

ARTICLE VIII.

Auditors.

Two Auditors, to be elected by ballot, shall audit the accounts of the Association annually, and present their report of the same at the Annual General Meeting.

ARTICLE IX.

Subscriptions.

1. The fee for membership for Active Members shall be five dollars, and an annual subscription of two dollars for each subsequent year; both payable in advance.

2. The fees of Active Members shall be forwarded to the Secretary-Treasurer with the ballot papers for election of Officers, and any ballot unaccompanied by the fees mentioned in sub-clause No. 1 shall not be counted in the Election.

3. Associate Members shall pay a fee of two dollars annually.

4. The names of members twelve months in arrears shall be struck off of the roll.

BY-LAWS.

ORDER OF BUSINESS.

1.

1. Reading of Minutes of Previous Meeting.
2. Reading of Correspondence and Accounts.
3. Propositions for Honorary Membership.
4. Balloting for Honorary Membership.
5. Reports.
6. Unfinished Business.
7. New Business.
8. Election of Officers.
9. Adjournment.

2. All motions must be in writing, and shall contain the name of the mover and seconder, and must be read by the Chair before being discussed.

3. Reports of Committees must be in writing, signed by the Chairman thereof.

4. No member shall speak on any subject more than once, except the introducer of the subject, who shall be entitled to reply ; every member, however, shall have the right to explain himself, subject to the discretion of the Chair.

5. When a motion has been finally put to the meeting by the Chairman, all discussion thereon shall be closed.

6. The Chairman shall appoint two scrutineers when a ballot is taken.

7. Every member while speaking shall address the Chair.

DUTIES OF OFFICERS.

1. The President shall preside at all meetings at which he is present; in his absence the Vice-President; and in the absence of both the meeting shall appoint a Chairman.

2. The presiding officer shall only have a casting vote, not a deliberate one.

3. The Secretary-Treasurer shall keep an accurate record of all meetings, conduct all correspondence, announce all meetings, receive all fees and subscriptions and other moneys, pay no bills unless sanctioned by the Executive Committee and signed by their Chairman, make an annual report of all receipts and disbursements, and shall perform such other duties as may from time to time be assigned him by the Executive Committee.

PROGRAMME.

TUESDAY, FEB. 19, 9.30 A. M.

Meeting of Executive and Standing Committees for 1888; arrangement of Exhibits and other details.

TUESDAY, 2 P. M.

Reading of Minutes of Previous Meeting.
Reading of Correspondence.
Report of Executive Committee.
Report of Secretary-Treasurer.
Report of Auditors.
President's Address.

TUESDAY, 7.30 P. M.

PAPER—"A method of predicting Lunar Occulations."
W. F. KING, D.T.S., Ottawa, Ont.

PAPER—"Practical prospecting for Gold and Silver, and the preliminary developments of metalliferous veins."
JAS. BRADY, M.E., Grohman, B.C.

PAPER—"Reflection of the Electric Light."
OTTO J. KLOTZ, D.T.S., Preston, Ont.

LECTURE—"Supposed fossil-trees discovered at Kingston, Ont.," illustrated by Sciopticon Views, by H. N. TOPLEY, Photographer to the Technical Branch of the Department of the Interior, Ottawa, Ont.

WEDNESDAY, FEB. 20, 9.30 A. M.

Report of Standing Committee on Geodetic Surveying.
W. F. KING, D.T.S. (Chairman), Ottawa, Ont.

Report of Standing Committee on Publication.
T. D. GREEN, D.L.S. (Chairman), Brantford, Ont.

Report of Standing Committee on Land Surveying.
JOHN MCLATCHIE, D.L.S. (Chairman),
New Edinburgh, Ont.

Appointment of Scrutineers of Ballots.

WEDNESDAY, 2 P. M.

Questions, Problems and Formulas submitted to the Meeting.

PAPER—"The Status of our Profession."

J. W. HARRIS, D.L.S., Winnipeg, Man.

PAPER—"A Standard of Precision."

J. A. KIRK, D.L.S., Stratford, Ont.

PAPER—"Gunter's Chain."

S. BRAY, D.L.S., Ottawa, Ont.

PAPER—"Coal Mining."

C. A. MAGRATH, D.T.S., Lethbridge, N.W.T.

WEDNESDAY, 7.30 P. M.

PAPER—"Measurements."

J. H. BROWNLEE, D.L.S, Brandon, Man.

PAPER—"A Plea for Pioneers."

DR. ROBT. BELL, Assist. Director Geological Survey of Canada, Ottawa, Ont.

PAPER—"Hon. D. W. Smith, the first Surveyor General of Upper Canada."

JOHN McAREE, D.T.S., Toronto, Ont.

PAPER—"Photo-Topography in Italy" (translated from the Italian). Transmitted by Capt. E. DEVILLE, Surveyor General, to whom it was communicated by the Italian Geographical Institute, through the Royal Italian Consulate for Canada.

LECTURE—"The Instruments used in the Profession."

W. F. KING, D.T.S., Ottawa, Ont.

Microscopical Exhibit of Biological and Rock Specimens.

Messrs. ADAMS & LAWSON, Geological Survey of Canada, Ottawa, Ont.

THURSDAY, FEB. 21, 9.30 A. M.

Report of Standing Committee on Natural History and Geology.

Prof. JOHN MACOUN, F.L.S. (Chairman), Ottawa, Ont.

Report of Standing Committee on Permanent Marking of Surveys.

S. L. BRABAZON, D.L.S. (Chairman), Portage-du-Fort, Que.

Report of Standing Committee on Photography as applied to Topographical Surveying.

W. S. DREWRY, D.L.S. (Chairman), Belleville, Ont.

Report of Standing Committee on Topographical Surveying.

OTTO J. KLOTZ, D.T.S. (Chairman), Preston, Ont.

Report of Scrutineers of Ballots.
Unfinished Business. New Business.
Arrangement of Committees for 1889.

THURSDAY, 2 P. M.

Meeting of Committees for 1889.

PAPER—" Irrigation."
THOS. FAWCETT, D.T.S., Gravenhurst, Ont.

PAPER—" Distance Measuring Micrometers."
W. F. KING, D.T.S., Ottawa, Ont.

LETTER—" Suggestions *re* Forestry."
A. T. DRUMMOND, Montreal, Que.

PAPER—" Settlement and Irrigation of the portions of the N. W. Territories West of the Eastern limit of the Missouri, Coteau, and South of Tp. 30."
WM. PEARCE, D.L.S., Calgary, N.W.T.

THURSDAY, 7.30 P. M.

PAPER—" Suggestions regarding Geographical Nomenclature."
A. T. DRUMMOND, Montreal, Que.

PAPER—" Government Surveys in Manitoba and the North-West."
J. S. DENNIS, D.T.S., Ottawa, Ont.

PAPER—" Surveys of the Province of Quebec."
G. E. MCMARTIN, D.L.S., St. Andrews, Que.

LECTURE—" How to preserve Natural History Specimens."
A practical illustration will be given of the best and easiest methods of preparing skins for future mounting.
Prof. JOHN MACOUN, F.L.S.,
Geological Survey of Canada, Ottawa, Ont.

Adjournment.

Full discussion after each Paper, open to all.

EXHIBITS.

INSTRUMENTS.

The exhibit of Instruments was large and comprehensive, and owing to the kindness of Capt. C. Deville, Surveyor General, Staff Commander Boulton, and Mr. G. B. Abrey, included many used only in the higher branches of Surveying. They were as follows :—

25 Inch Alt-Azimuth.
18-Inch Alt-Azimuth.
10-Inch Alt-Azimuth.
7 Inch Alt-Azimuth.
Prismatic Transit.
Astronomical Transit.
4 Inch Transit Theodolite.
Solar Compass.
Lugueol Micrometer.
Standard Steel Tape.
Reflecting Circle.
Artificial Horizon.
Exploring Theodolite.
4 Inch Prismatic Transit.
Reflecting Telescope.
Dip Circle.

Station Pointer (used by Staff Commander Boulton on Hydrographic Survey of the Georgian Bay).

German Rolling Planimeter (a description of this instrument as given by Mr. Abrey will be found further on).

Mr. Brownlee exhibited a simple clip for mending a broken steel band chain, and also field tools for applying the same. The box of tools required is about 4 x 2 x 1 inches, and weighs about a pound, being easily carried by the chainman along with the field-book.

PHOTOGRAPHIC VIEWS.

Mr. H. N. Topley had a large exhibit of Photographs, tastefully arranged about the hall, from negatives taked by Dr. Dawson, Dr. Bell and Mr. J. B. Tyrrell of the Geological Survey, and by Mr. William Ogilvie. Among the Views may be mentioned :—

Large Photographs of the Public Buildings in Washington, D.C.

Enlarged Photographs of scenery on the Yukon River.

Italian Topographical Photographs (loaned by Capt. E. Deville).

Medical Photographs, taken by Dr. Grey of the Army and Medical Museum, Washington, as follows:

The human hand in embryo, two and a half months old (enlarged 50 diameters).

Fimbriated papilloma of the bladder (enlarged 250 diameters).

Epithelioma of lip (enlarged 125 diameters), Ciliary Region of human eye.

Retina of human eye (enlarged 200 diameters), Human hair (enlarged 400 diameters.

Eggs of tricocephalus dispar in the liver of a mouse (enlarged 400 diameters). Bacillus aceti (enlarged 1250 diameters). Prof. Smillie of the National Museum of Washington also kindly sent Mr. Topley some photographs of fossil trees. These trees are now placed in front of the Museum, and are said to be the largest specimens exhibited in America.

MICROSCOPICAL.

A Microscopical Exhibit was given by Dr. A. C. Lawson, Mr. F. D. Adams and Mr. J. B. Tyrrell of the Geological Survey.

Dr. Lawson and Mr. Adams exhibited a full suite of rock hand, specimens of typical massive rocks, showing gradation from glassy or porphyritic surface rocks to coarse grained granular deep-seated rocks; also microscopical sections of these hand specimens, showing their characters under the microscope.

Mr. J. B. Tyrrell exhibited under the microscope *Foraminifera* from *Cretaceous* (chalk) formation in Western Canada.

The mechanism of the instruments used and the methods of petrographical research were briefly explained.

NATURAL HISTORY.

Mr. J. Edwards, Taxidermist, exhibited two deer heads and a brace of Ptarmigan (mounted).

MINUTES.

TUESDAY, Feby. 19th.

The morning was spent in meetings of the several committees, and in arranging the Hall and various Exhibits.

Afternoon Session.

The meeting opened at 2.40 p. m., the President, E. J. RAINBOTH, in the Chair.

The Secretary-Treasurer being unavoidably absent, on motion, Mr. T. D. GREEN was appointed to act *pro tem.*

The Minutes of the preceding Annual Meeting were disposed of by Resolution No. 2.

Moved by T. D. GREEN, seconded by J. H. BROWNLEE, and *Resolved*:—

That the minutes of the last meeting be adopted as printed in the 5th Annual Report, as they are shown very fully therein, and have been seen by all the members.

At the request of the President, Mr. J. S. DENNIS read the correspondence, the same having been placed in his hands by the Secretary-Treasurer.

Letters were received from the following:—

A. W. McVittie, D.L.S., drawing the attention of the Association to the probability of the British Columbia, and possibly the Dominion Government, appointing Government Assayers to mining districts, and to the advisability of that official being also a Government Surveyor, which would mean a D.L.S. in the office of Government Assayer, and thereby necessitating a more practical study of mineralogy for the degree of D.L.S.

Prof. Galbraith, S.P.S., acknowledging his election as an Honorary Member, and hoping to be able to find time in the future to write a paper for the Annual Meeting.

Wm. Murdoch, A. J. Brabazon and N. A. Freeman, Dominion Land Surveyors, applying for membership.

A. M. Burgess, Deputy Minister of the Department of the Interior, regretting that owing to the period of the year he would be unable to attend the Meeting.

Messrs. Keuffel and Essex, of New York, expressing an intention of exhibiting some of their Surveying instruments, tapes, scales, etc., provided they could do so without paying duty thereon. On consulting the Minister of Customs in the matter, the Secretary-Treasurer was informed that such an exhibit would be looked upon as samples of merchandise, and would be, therefore, dutiable.

Governor General's Secretary, acknowledging receipt of Fifth Annual Report, and conveying thanks on behalf of His Excellency for same.

Mr. DENNIS reported that a ballot had been handed to him that day, and asked whether it should be received. Discussion was closed by Resolution No. 3.

Moved by WM. OGILVIE, seconded by G. B. ABREY, and *Resolved :*

That all ballots presented at the Meeting, up to the time of the appointment of the Scrutineers, be received and counted.

The report of the Secretary-Treasurer and the statement of Receipts and Expenditures were read.

The PRESIDENT referred briefly to the deaths of Messrs. J. A. Snow and C. E. Wolff, both of whom were members of the Association, and of Messrs. Fisher and Duderidge, members of the Profession.

After discussion it was decided that the amount of work to be done would not warrant the Association in the purchase of a typewriter for the use of the Secretary-Treasurer.

The PRESIDENT then delivered his Annual Address.

PRESIDENT'S ADDRESS.

GENTLEMEN,

MEMBERS OF THE ASSOCIATION OF DOMINION LAND SURVEYORS,

As a member of this Association, it affords me much pleasure to meet again my fellow members in a gathering such as this—a gathering which cannot fail to be productive of the best results in its tendency to forget graver considerations, to promote harmony and good-will among the members of this organization, and in disarming any unfriendliness that might possibly be engendered by those contests and rivalries which are incidental to professional life. It is a pleasure in which I have always participated since our first or preliminary meeting at Winnipeg in 1882, and as the annual address of your president forms part of the programme for occasions such as this, I thought perhaps I could not do better, discharging this, to me, unaccustomed duty, than by briefly referring to the different stages through which our profession has passed in reaching its present efficiency, and attaining as it has within the past few years no insignificant place among the liberal professions of the country.

When I attended the meeting in Winnipeg, to which reference has just been made—a meeting attended but by very few, and of a somewhat casual nature—it was agreed upon to defer further proceedings until the following winter, and it was thought that Ottawa would be the most convenient place to assemble for the purpose of forming an Association of Dominion Land Surveyors. In accordance with this understanding, a meeting was duly convened at Ottawa with that object in view, and as most of you will readily remember it was attended by Surveyors from almost every part of the Dominion. At this meeting this Association was organized, an Association constantly increasing in importance, in which every Surveyor takes, as we know, a deep interest, and which has, I will venture to say, rendered most valuable assistance to our profession.

The progress that has been made in the systems and practice of surveying in Canada may perhaps be most accurately comprehended, by contrasting the old methods and the instruments deemed sufficient for the execution of the work then required to be performed, with the methods that are followed at present, and the improved instruments that are now necessary for the satisfactory execution of a survey. In former years the surveyor was the chief and also the leader of his party in a very practical manner, sharing in all the manual labor, and to a stranger, hardly distinguishable from the laborers of his party, living as he did in the most indifferent way; he frequently returned to civilization, possessing it is to be hoped a refinement which his outward appearance would never have betrayed. His most, indeed his only, essential instrument was a magnetic compass, which was then thought by those who should have known better, to possess, in some mysterious manner, the highest degree of accuracy, and which it was believed that science could not improve nor modern instruments rival. In fact, he was very little above an ordinary laborer in name or remuneration, his profession was called his trade, and his instruments his tools. This age or period in surveying had almost entirely disappeared when I first began the study of the profession, and the traces of it that I observed and that are still observable are not such as would inspire one with admiration for the profession, or envy the duties and tasks its members were called upon to perform. Now happily, however, his position is wholly different, the accuracy now demanded in his work requires the careful and assiduous exercise on his part of all his scientific information, alike in his theoretical conception of the work and in the actual execution of it ; this latter requires that he be thoroughly posted in the use of all modern and improved instruments that have been invented for the measurement of distance and location of position.

A surveyor is at the present day regarded and treated in the light of a professional man ; those who secure his services understand that he expects to live somewhat at least in the manner becoming a professional man, and as such to conduct and manage his party ; they are aware that the work he is to perform demands scientific information, and they engage him because he is supposed to possess it, and they expect to pay, and in most cases actually do pay, him something like an adequate remuneration for the services he renders. It is evidently the unquestionable and first duty of the members of our Profession, and especially of this Association, to jealousy guard against any innovation of a nature to diminish the efficiency of the profession, or to impair, in the slightest degree, the standing of its members, or the privileges they have lately been accustomed to enjoy ; and it must also be evident that we can only maintain our present standing, and hope for still further advancement in the future, by striving to improve our methods of executing work, by adding to our scientific and practical knowledge, and by encouraging a feeling of friendliness towards all our associates, and of independence and manliness in our transactions with the public. In this respect we must acknowledge that much of our advancement can be traced to the kindly interest that has been taken in our Association by some of the officials of the Interior Department, and the improved systems of surveying that have from time to time been devised by them, and I believe that when we reflect that the present Minister to his many other requirements possesses the technical information of the surveyor and engineer, we have every reason to hope that the amicable spirit that has characterized our dealings with the Department in the past will continue to distinguish all such dealings in the future, and I feel confident that any further efforts made by us in carrying out the aims of this Association will meet with their sanction and assistance, and commend themselves to the favorable consideration of the Minister and those of his Department whose approval may be necessary for their effective accomplishment.

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I may here refer to the question of incorporation. You are aware that it was once a live question before this Society, and you will recall how warmly it was advocated, and that it was the wish of this Association that the Dominion Land Surveyors should be legally incorporated. It is needless for me to state that all our exertions led to nothing. In the Province of Quebec, however, all admit that incorporation has been productive of the best results; but at the same time, it must be owned that its success is generally attributed to the large private business that is to be found there. Whether incorporation would at present bring about here—where there is scarcely more than one source of employment—a like result, is of course still dabateable. Since the curtailment in surveying in the North-West, we see some surveyors turning their attention almost entirely to engineering in all its various branches, and it has occurred to me that perhaps the usefulness of this Association, as a factor in promoting the efficiency and raising the standard of our Profession, would be enhanced by enlarging the scope of the Society, and by not limiting its active membership to Dominion Land Surveyors. I entertain the opinion that the general absence of private practice for Dominion Land Surveyors will not enable us to keep up that interest in this Society, in the future, that has been so generously evinced for it in the past, and that distinguish its members at present, considering the intimate connection existing between the profession of the civil engineer and our own. The idea is impressed upon me, that if we admit others to our Association, changing its name say to that of the Dominion Association of Land Surveyors and Engineers, and having its deliberations cover a broader field, and take in, in their comprehensive scope, all subjects pertinent to both professions, in this way many would be induced to join us who are now ineligible, we would have in our ranks professional land surveyors from all the provinces, and also many engineers; in this manner a society might, I believe, be formed, in which the topics of discussion would interest others besides those actually engaged in the survey of Dominion lands, and which consequently would not be dependent for its existence on the continuance of government work. A programme of the proceedings proposed for the consideration of the present meeting of this Association has been carefully prepared and sent to each member showing the work allotted for each day and sitting, and the subject of the different papers to be read, which will obviate the necessity of my dwelling in detail upon the nature of the subjects to be treated.

I have in conclusion to ask that you will give an attentive hearing to the various readings, which have all been prepared, I feel confident, with great care and labor. I have also to request that those whose names are not upon the programme will have no hesitation in expressing their ideas, not only on matters referred to in the programme, but also on all affairs concerning in any manner this Society in which we are all equally interested, and which we all wish to see prosper and increase in importance and usefulness.

E. J. RAINBOTH,
President.

Evening Session.

The meeting was called to order at 8 p.m., E. J. RAINBOTH, President, in the Chair.

A PAPER, "Method of predicting Lunar Occultations," was read by W. F. KING, and followed by discussion.

A PAPER, "Practical prospecting for gold and silver, and the preliminary developments of metalliferous veins," by JAS. BRADY, was read by T. D. GREEN, and followed by discussion

A PAPER, "Reflection of the Electric Light," was read by OTTO J. KLOTZ, and discussed.

A LECTURE, "Supposed fossil trees discovered at Kingston, Ont.," was given by H. N. TOPLEY. Mr. Topley's lecture was illustrated by Siopticon views, including many outside the subject of the lecture. (A synopsis of Mr. Topley's lecture and exhibit will be found further on.) This closed the Evening Session.

WEDNESDAY, Feb. 20th.

Morning Session.

The meeting was called to order at 10.30 a.m., E. J. RAINBOTH, President, in the Chair.

No Report of Standing Committee on Instruments was presented, the Chairman, G. B. ABREY, stating that none had been prepared, as he felt assured that the lecture on "Instruments used in the Profession," by W. F. KING, would include all the Committee could say on the subject.

Report of Standing Committee on Geodetic Surveying.

Report of Standing Committee on Publication.

Report of Standing Committee on Land Surveying.

Resolution No. 4.

Moved by G. E. McMartin, seconded by W. S. Drewry, and *Resolved:*

That the several reports of the standing committee be accepted.

Resolution No. 5.

Moved by Walter Beatty, seconded by Edgar Bray, and *Resolved:*

That the Secretary supply members of the Association who have not received blank forms of ballot, with the same.

Resolution No. 6.

Moved by Walter Beatty, seconded by W. S. Drewry, and *Resolved:*

That Messrs. E. Bray, Snow and Crawford be appointed scrutineers of ballots for election of Officers.

Afternoon Session.

The meeting was called to order at 2 p.m., E. J. Rainboth, President, in the Chair.

A graphic method of dividing a Quadrilateral into any number of equal parts, by H. Irwin, was adopted as read, as no proper means had been provided to follow out the geometrical figures.

A Paper, "Gunter's Chain," was read by S. Bray.

A Paper, "The Status of our Profession," by J. W. Harris, was read, and followed by considerable discussion.

A Paper, "A Standard of Precision," by J. A. Kirk, was read.

A Paper, "Coal Mining," by C. A. Magrath, brought the afternoon session to a close.

Evening Session.

The meeting was called to order at 7.45 p.m., E. J. Rainboth, President, in the Chair.

J. H. Brownlee stated that owing to a misunderstanding having occurred, he had failed to prepare a paper, as per programme, but that he would consent to say a few words about improvements in Steel-band Chains, invented by A. J. Brabazon, D.L.S. (See further on.)

A large portion of the evening was taken up by a question of privilege, and several motions were passed in connection therewith.

MR. F. D. ADAMS and DR. LAWSON, of the Geological Survey, gave a microscopical exhibit of Biological and Rock Specimens, a description of which will be found under the heading "Exhibits."

Resolution No. 11.

Moved by OTTO J. KLOTZ, seconded by J. S. DENNIS, and *Resolved:*

That a sincere vote of thanks be tendered Messrs. Lawson and Adams for their kindness in exhibiting their Microscopes and Specimens.

THURSDAY, Feb. 21st.

Morning Session.

The meeting was called to order at 10 p.m., JOHN MCAREE, Vice-President, in the Chair.

A PAPER, "A Plea for Pioneers," by DR. ROBERT BELL, was read and discussed.

A PAPER, "Hon. D. W. Smith, the first Surveyor General of Upper Canada," was read by JOHN MCAREE.

A PAPER, "Azimuth by means of two Stars," by S. L. BRABAZON was read and discussed.

Report of Standing Committee on "Photography as applied to Topographical Surveying," W. S. DREWRY, Chairman, was presented and discussed.

Report of Standing Committee on "Topographical Surveying," OTTO J. KLOTZ, Chairman.

Remarks by J. S. DENNIS, regarding work of committee on "Geodetic Surveying."

Report of scrutineers of Ballots.

Resolution No. 12.

Moved by W. S. DREWRY, seconded by G. MONTAGU-WHITE, and *Resolved:*

That the report of the scrutineers be received and adopted.

Resolution No. 13.

Moved by W. S. DREWRY, seconded by WM. CRAWFORD, and *Resolved:*

That the list of exchanges be left in the hands of the Executive Committee.

Resolution No. 14.

Moved by Wm. Crawford, seconded by J. C. Nelson, and *Resolved:*

That a vote of thanks be tendered to Mr. Wheeler, Secretary of the Association, and that he be paid fifty dollars as a recognition of his services.

Resolution No. 15.

Moved by A. O. Wheeler, seconded by J. S. Dennis, and *Resolved:*

That clause IX of the constitution be amended by adding the following subclause: "The names of all members, twelve months in arrears, shall be struck off the roll."

Resolution No. 16.

Moved by E. Bray, seconded by William Crawford, and *Resolved:*

That the Executive Committee be authorized to strike the Standing Committee for the current year.

Resolution No. 17.

Moved by Wm. Crawford, seconded by J. C. Nelson, and *Resolved:*

That the Executive Committee be and are hereby authorized to retain a solicitor in Winnipeg and Victoria, to look after those practicing surveying in Manitoba, the North West and British Columbia, who are not duly qualified.

Afternoon Session.

The meeting was called to order at 3 p.m., John McAree, Vice-President, in the Chair.

A Paper, on "Irrigation," by Thomas Fawcett, was read and discussed.

A Letter from A. T. Drummond, of Montreal, containing suggestions relating to "Forrestry," was read and discussed.

Resolution No. 18.

Moved by Otto J. Klotz, seconded by Wm. Crawford, and *Resolved:*

That a vote of thanks be tendered Mr. Drummond for the valuable suggestions contained in his letter.

A Paper, "Settlement and irrigation of the portions of the N.W. Territories West of the Eastern limit of the Missouri Coteau, and South of the Tp. 30," by Wm. Pearce, was read and discussed.

A Paper, "Government Surveys in Manitoba and the North-West," was read by J. S. Dennis, and followed by discussion.

A Paper, "Distance measuring Micrometers," was read by W. F. King, and was followed by an explanation of the use of the micrometer by Wm. Ogilvie.

A Lecture on "The Instruments used in the Profession," by W. F. King, brought the Afternoon Session to a close. (A synopsis of the lecture will be found further on.)

Evening Session.

The meeting was called to order at 8 p.m. John McAree, Vice-President, in the Chair.

G. B. Abrey gave an explanation of the use of a Rolling Planimeter, exhibited by him, and an interesting discussion accompanied by some tests of its practical value took place.

A Paper, "Suggestions regarding Geographical Nomenclature," by A. T. Drummond, was read and discussed.

A Lecture, on "How to preserve Natural History Specimens," by Prof. John Macoun, included practical illustration of skinning birds and deer heads, by J. C. Edwards, taxidermist.

Resolution No. 19.

Moved by G. B. Abrey, seconded by William Ogilvie, and *Resolved:*

That a vote of thanks be tendered to Prof. Macoun for his instructive address.

Report of Auditors was presented and on motion adopted.

A Paper, "Photo-Topography in Italy," submitted by Capt. E. Deville, Surveyor General, was read.

A Paper, "Surveys of the Province of Quebec," was read by G. E. McMartin, and discussed.

It was then moved by J. S. Dennis, seconded by J. H. Brownlee, and *Resolved:*

That this meeting do now adjourn until the third Tuesday in February, 1890.

NAMES OF MEMBERS PRESENT.

Honorary Members.

W. F. King, D.T.S., Chief Astronomer to the Dept. of the Interior of Canada.

Prof. John Macoun, F.L.S., Naturalist and Botanist to the Dept. of the Interior of Canada.

Active Members.

Abrey G. B.
Beatty Walter
Belleau J. A.
Bigger C. A.
Bowman H. J.
Brabazon A. J.
Bray Edgar
Bray Samuel
Breen Thomas
Brownlee J. H.
Crawford Wm.
Dennis J. S.
Drewry W. S.
Dufresne I. J.
Dumais P. T. C.
Freeman N. A.
Green T. D.
Klotz Otto J.
Morency D. C.
Mountain Geo. A.
McAree John
McArthur J. J.
McMartin G. E.
McLatchie John
Nelson J. C.
Ogilvie Wm.
Rauscher Robt.
Rainboth E. J.
Snow J. F.
Webb A. C.
White Geo. Montagu.

Associate Members.

Brummell H. P.
McEvoy James
Smith W. H. C.
Symes P. B.
Topley H. N.
White James

Visitors.

A. T. Drummond, Montreal,
John Ogilvie, D.L.S.
Dr. A. C. Lawson, Geological Survey, Ottawa,
F. D. Adams, " " "
J. B. Tyrrell, " " "
A. P. Low, " " "
E. R. Faribault, " " "
Robt. Chalmers, " " "
W. McInnes, " " "
W. McL. Maingy, Dept. of the Interior,

M. Brady, Dept. of the Interior,
D. W. Lightfoot, Dept. of Public Works,
P. K. Hyndman, Dept. of Railways and Canals,
John Bobier,
J. H. Doherty,
R. K. Claire,
Wm. Canning.

NEW MEMBERS.

Active.

A. J. Brabazon	Portage du Fort, Que.
T. W. Chalmers	Battleford, N. W. T.
Joseph Cozens	Sault Ste Marie, Ont.
J. L. Doupe	Winnipeg, Man.
N. A. Freeman	Milton, N. S.
Maurice Gaviller	Collingwood, Ont.
H. Irwin	Montreal, Que.
D. C. Morency	Levis, Que.
Wm. Murdoch	St. John, N. B.
A. L. Poudrier	Donald, B. C.
T. J. Patten	Little Current, Ont.
Arthur St. Cyr	Ste Anne de la Perade, Que.
John Vicars	Cannington, Ont.

Associate Members.

C. M. Odell	Truro, N. S.
P. B. Symes	Dept. of the Interior, Ottawa, Ont.
H. N. Topley	Dept. of the Interior, Ottawa, Ont.

REPORTS.

REPORT OF SECRETARY-TREASURER.

OTTAWA, Feb. 16th, 1889.

TO THE PRESIDENT AND MEMBERS OF THE ASSOCIATION
OF DOMINION LAND SURVEYORS.

GENTLEMEN,

I have the honor to make the following report of transactions during the past Association Year, extending from the 15th March, 1888, to the 18th February, 1889 (incl.)

As many of you gentlemen who were present at our last Annual Meeting will know, it was decided that a strong effort should be made to place the Association upon a better and firmer footing than heretofore, and to make the interchange of professional scientific works, thoughts and ideas the chain that was to bind us together in the future. I have great pleasure in informing you that the expectations of that meeting have been more than realized, and that we may consider our Association as holding one of the highest, if not the highest place amongst similar Associations and Societies in Canada or the United States.

Referring to the subject of Resolution No. 1, passed at the last Annual Meeting, I beg to state that the matter has been brought before the heads of the Department of the Interior, and is now under consideration,—and I think, I may say, favourable consideration. No action has been taken with any other Department, pending the decision of the Minister of the Interior, with regard to Interior and Geological Survey Reports and Maps.

As to Resolution No. 6, a copy of the 5th Annual Report, only, was sent to the Canadian Institute, and duly acknowledged; all other Reports being out of print.

By Resolution No 7, I was instructed to effect an exchange of Reports with the following Societies: Ohio, Michigan, Illinois, Connecticut, Colorado, and the P. L. S. Association of Ontario, to the extent of 50 copies to each. The first four gladly agreed to an exchange; Colorado would have been happy to do so, but published no Report last year. The Secretary-Treasurer of the last named Association writes, that in his opinion all D. L. S's who reside in

Ontario belong to the Association of P. L. Surveyors, and, therefore, that they get both proceedings ; and for the *very few* outside of Ontario it would not pay to bother with them. In lieu therefore of the two last mentioned, arrangements were made for an exchange with the Societies of Indiana and Arkansas.

In every case it was found that a full exchange would be necessary, and consequently the following distribution was made : Ohio, 110 copies ; Michigan, 100 copies ; Connecticut, 90 copies ; Illinois, 75 copies ; Indiana, 75 copies ; and to Arkansas, 40 copies ; the most that could be spared as no previous arrangements had been made for such exchange. The total number, therefore, disposed of in this manner was 490 copies.

Seven hundred copies of the Annual Report were printed, at a cost of $1.10 per page for 157 pages. As stated above, 490 copies were received by our exchanges ; 110 copies were distributed in a manner thought to be most beneficial to the Association, and the remainder, with the exception of half-a-dozen copies now in hand, went to supply the requirements of our own members.

In addition to the Report, two pamphlets were issued : one by the Executive, and one by a special committee, and were distributed to all the Dominion and Provincial Land Surveyors in Canada, whose addresses could be obtained with any degree of certainty. As the committees dealing with these will probably report concerning the same, I will only add that 1,000 copies of each were printed, with an accompanying circular, at a total cost of $26.55. Of this number between four and five hundred of each kind are now on hand.

Since the publication of the list of members in the 5th Annual Report, the following D. L. S's have joined the Association, viz. : Messrs. A. L. Poudrier, Maurice Gaviller, H. Irwin, T. W. Chalmers, Jos. Cozens, A. J. Brabazon, J. L. Doupé, Arthur St. Cyr and John Vicars, while the Executive Committee have admitted Messrs. H. N. Topley, C. M. Odell and P. B. Symes to Associate Membership.

363 letters have been received up to the 13th inst., and 518 letters have been written. While on this subject I may say that the work of the Secretary-Treasurer would be much lighter, neater and more business-like, did the Association possess a type-writer, and as a certain amount of work must always be done on a typewriter, that item of expense would be done away with were such the case. I would therefore strongly urge upon this meeting, that the Secretary-Treasurer be authorized to purchase one, upon the best

possible terms, provided that the same can be done without loss to the Association.

Within the past year several Reports of the Department of the Interior, neatly bound, have been presented, as a contribution towards a library, by Mr. J. S. Dennis.

Regarding the finances of the Association, I beg to submit the annexed statement of Receipts and Expenditures. In connection therewith I would draw your attention to the following facts.

Dues received during year, terminating March 8th, 1887—$58.00; during year terminating March 14th, 1888—$100.00; during year terminating Feb. 18th, 1889—$208.00; while dues paid in advance for year terminating in Feby., 1890—$89.00; or in other words, dues for 1886 amounting to $83.00; dues for 1887 amounting to $87.00, and dues for 1888 amounting to $187.00.

Income from advertisements in Fourth Annual Report—$30.00; income from advertisements in Fifth Annual Report—$39.00; income from advertisements for Sixth Annual Report, as far as known—$62.00.

Sale of Annual Reports in 1887—50c.; sale of Annual Reports in 1888—$2.52.

The above quotations require no comment.

In conclusion, I would remind you, gentlemen, that during the past year, two of our "Original Land-marks" have been removed by death: J. A. Snow, one of the oldest and best known surveyors in the Ottawa valley; and C. E. Wolff, one of those who risked their lives in 1885 on the behalf of peace and order. Let us hope that their "meridian" was "true," and that they have at length reached that point which should have been the "Pole Star" of their ambition.

I have the honor to be, Gentlemen,

Your obedient servant,

ARTHUR O. WHEELER,

Secretary-Treasurer.

RECEIPTS AND EXPENDITURES

FOR YEAR EXTENDING FROM MARCH 15TH, 1888, TO FEBRUARY 15TH, 1889 (INCL.)

RECEIPTS.

By Balance on hand	$243 26	
“ Sale of Annual Reports	2 52	
“ Refund of pre-paid duty on Exchs	5 00	
“ Advts. in Fifth Annual Report	36 00	
“ “ for Sixth “ “	5 00	
“ dues for 1885	5 00	
“ “ 1886	11 00	
“ “ 1887	18 00	
“ “ 1888	174 00	
“ “ 1889	89 00	
		$588 78

EXPENDITURES.

To Rent of Hall for Annual Meeting	$ 5 00	
“ Sec.-Treas. for services	20 00	
“ Lithographing for Fifth Annual Report	10 00	
“ Publishing, printing and prepayment of duty on exchanges by John Lovell & Son	200 00	
“ Purchase of reduced railway fare certificates	1 00	
“ Discount on American cheque	15	
“ Advertisement for shorthand writer	1 00	
“ Stationery	6 10	
“ Telegraph and Telephone	1 25	
“ Freight and Expressage	18 10	
“ Type-writing	9 00	
“ Cab hire and cartage	1 97	
“ Duty on electros	1 26	
“ Postage	36 26	
		$311 09
Balance on hand	$277 69	

OUTSTANDING LIABILITIES.

To Hope & Co., stationery and printing	$ 3 90	
“ A. S. Woodburn, printing and stationery	39 25	
		$43 15

REPORT OF AUDITORS.

OTTAWA, Feb. 21st, 1889.

TO THE PRESIDENT AND MEMBERS OF THE ASSOCIATION,

GENTLEMEN,

We, the undersigned Auditors, have examined the accounts of the Association, and find them kept with care, and correctly. There is a balance to the credit of the Association of $277.69, and outstanding liabilities of $43.15 ; the Bank deposit of $294.44, as shewn by the bank book, agrees with the statement given us by the bank.

T. D. GREEN,
E. G. MACMARTIN.

NOTE :—As will be seen from the above, the bank deposit exceeded the balance shown by the Sec.-Treasurer's statement; this may be accounted for by the fact that sundry amounts were paid in subsequent to the closing of the accounts of the Association and the submitting of the same to the auditors.

SECRETARY-TREASURER.

REPORT OF STANDING COMMITTEE ON GEODETIC SURVEYING.

TO THE PRESIDENT AND MEMBERS OF THE ASSOCIATION
OF DOMINION LAND SURVEYORS.

GENTLEMEN,

The Standing Committee on Geodetic Surveying beg to report as follows :—

The term "Geodetic Survey" may properly be applied to all surveys of precision of such extent that the curvature of the earth has to be taken into consideration. This distinguishes Geodetic Surveys from those made for the purposes of settlement merely, which come under the purview of the Standing Committee on Land Surveying.

Although the Dominion Lands township surveys have been made on a very large scale, more extensive in fact than have been many Trigonometrical and Geodetic Surveys ; and although the Dominion Lands system is consequently based necessarily on consideration of the figure of the earth, yet the practical execution of these surveys in detail is a matter of simple surveying.

The Standing Committee on Geodetic Surveying are, therefore, restricted to surveys, such as are referred to in the Dominion Lands Act, as "extensive governing surveys." The Committee have to say that no surveys of this kind have lately been made in Canada, and so they have nothing new to lay before the Association, and they have failed to induce members to contribute papers on subjects within their domain. Furthermore, they cannot extend their researches into the region of Exploratory and Topographic Surveys, &c., by the fact that the Standing Committees on Topographical Surveying and Photography bar the way.

Again, the one subject which has come before the Association, and which this Committee is in a position, as a Committee on Geodetic Surveying, to discuss, namely, the proposed Trigonometrical Survey of Canada, has been delegated by the Association to a special committee appointed for the purpose.

The Standing Committee on Geodetic Surveying feel, therefore, that, like Othello, "their occupation's gone," for the present year at least, and they beg to report that they have done nothing.

W. F. KING,
Chairman.

REPORT OF STANDING COMMITTEE ON PUBLICATION.

To the President and Members of the Dominion
Land Surveyors' Association.

Gentlemen,

The Standing Committee on Publication have the honor to submit the following report of the printing and publishing performed since the last annual meeting.

As soon as a proper estimate of the number of pages and the number of Reports to be issued was ascertained, the Secretary-Treasurer solicited tenders for the printing thereof from the principal printing establishments of Canada, and when these tenders were received, a meeting of this Committee was called, and then decided to award the contract to J. Lovell & Son, of Montreal, on account of their prices, style, and experience in such reports. This firm, at the same rate, also printed the Memoranda of the different committees on Geographical Nomenclature and Orthography, and on the question of a Trigonometrical Survey of the Dominion.

On the whole, the printing and general construction of the Report and Memoranda are creditable; but, as it is desirable to produce as neat and compact a Report as possible, any suggestions regarding the improvement of the publication of the next Annual Report will be thankfully received.

Owing to our professional callings to the Northwest Territories, we regret to state that we have been unable to properly attend to our duties in this matter; and your worthy Secretary-Treasurer, with his customary zeal, has attended to the duties in connection with this branch of the Association during our absence, and we wish to take this opportunity of thanking him for his kindness.

The total amount of printing and publishing done since the last annual meeting is as follows:

125	Copies of a circular, issued for the purpose of notifying a member that his subscription was due, as well as a resolution of the reduction of 50 per cent. of the arrears, provided that reduced amount be forwarded before the 1st day of May.
200	Copies of forms for name, degree or degrees, occupation and address of the individual members.
225	Copies of a circular, giving a synopsis of the proceedings of the last annual meeting.
750	Sheets of official note paper.
1000	Official envelopes.
2000	Official wrappers.
250	Sheets for statements of accounts.
100	Circulars soliciting the presence of, and a paper from, the different members of this Association.
100	Nomination papers.
100	Ballot papers.
100	Envelopes for ballot papers.
400	Announcements, programmes, and invitations.
1000	Circulars soliciting any information which would tend to show the benefits of reliable maps compiled from data of a Trigonometrical Survey.
1000	Copies of the Memorandum submitted by the committee appointed to consider the question of a Trigonometrical Survey of the Dominion.
1000	Copies of the memorandum submitted by the committee on Geographical Nomenclature and Orthography.
700	Copies of the fifth annual report of the proceedings of this Association.

This concludes the printing and publishing for the past year, but will doubtless be increased the coming year, as it is deemed expedient to issue 1,000 copies of the next annual report.

In conclusion, we beg to suggest that the Association authorize and instruct the Secretary-Treasurer to procure a stamp, bearing the arms of the Dominion, supported by the lion and unicorn, and to have all papers and reports of this Association marked with the same. All of which is respectfully submitted.

Signed on behalf of the Committee.

T. D. GREEN,
Chairman.

REPORT OF STANDING COMMITTEE ON LAND SURVEYING.

To the President and Members of the Association of Dominion Land Surveyors.

Gentlemen,

The "Regulations for the government of survey parties in the field," submitted at the last annual meeting of the Association, by John MacAree, Esq., D.T.S., of Toronto, having been referred to the Committee on Land Surveying, they beg to report as follows, viz.:

That we believe rules or regulations will not make men more serviceable than they naturally are; that men employed on surveys should be engaged as laborers, and should do anything required of them. In our opinion it does not follow because a man wishes to engage to perform certain duties, that he will be able to fulfil his engagement more satisfactorily than some other member of the party that the surveyor may choose himself. Men employed on surveys are not usually overburdened with wealth, and when engaging are quite willing to agree to anything to get employment. The surveyor should make his own selection, from the members of his party, of those best suited to fill the different positions; and as men unacquainted with survey work will usually require some training, he should show every man what to do and how to do it. He should never allow loafing or shirking of duties. Should he not succeed in getting his men to do as he wants them, the sooner he dispenses with their services the better.

If on contract, a surveyor might engage his men at the highest rate of wages going, to perform certain work, should he be able to judge, according to the nature of the country, what would constitute a fair day's work. If not, he might engage his men at the common rate of wages; when they have become acquainted with their various duties, and have an idea how much work can be performed in a day, if all are good, willing men, offer them additional pay, say five or ten dollars per month, to keep up a daily average of a certain number of miles every day they work. Should any of the men be inclined to shirk their duties, offer 40, 60 or 80 dollars a month extra to the party, to be divided according to the actual value of each man's services in the party, so long as they keep up the same daily average every day they work. The men are then on contract as well as the surveyor, and are not only interested in the success of the expedition so as to secure their wages, but are also interested in securing the bonus. There will then be no grumbling about long or irregular hours of labor, no trouble about getting up in the morning, and no calculations as to the depth or temperature of a swamp or pond of water they may have to wade; but instead of this, there is a willingness and determination to overcome difficulties, while advantage is taken of everything they can think of to further the work.

The surveyor finds everything made ready to his hand, is saved an endless amount of trouble and annoyance, and will make two dollars for every one he has thus so judiciously expended.

Regarding surveys for the Government, when men are employed by the day, the situation is somewhat different. Usually the surveyor will have to give the full amount of wages allowed by the Government, to procure men for the work. There is then no chance of giving a bonus to the men, as the Surveyor cannot afford to give it out of his own pocket.

On contract whether the men get an additional allowance or not, their pay, to a certain extent, depends on the success of the expedition, and consequently on their own exertions. Men also that would do a fair day's work on a contract survey are useless on Government work. There are very few honest men when engaged on a Government survey; they have no idea of giving a fair day's work for a fair day's pay. We believe that experience has taught nearly all surveyors employed on Government work that this is true; also that a Government survey is considered to be a summer picnic, where work should not interfere with the pleasures of the party.

The pay is sure, so it makes no matter how little or how much work is accomplished.

When the party gets to work, some of them do not find it so agreeable an occupation as they had anticipated, consequently they begin to grumble, shirk their duties, and cause a general disturbance in camp. The only thing the surveyor can do is to discharge those that are dissatisfied, and take chances of replacing them with better men.

What difference will it make if he has read over those Regulations when engaging them? Or if they have been included in the contract or agreement? None, whatever; because if you have to discharge a man, whether under contract or verbal agreement, you must pay him his wages due, or otherwise he is not discharged, and could claim pay to the end of the season.

Men engaged under written contract for the season, and paid by the day, must be settled with up to the day they are discharged. While men signing a contract, agreeing to work a specified time for a certain sum of money, can be discharged at any time for incompetence or disobedience of orders, without receiving any pay.

We believe some men may be frightened by signing contracts, but it will rarely make them more agreeable, willing or valuable workmen than what they otherwise would be. Men that have been warned about long or irregular hours of labor, wading swamps and ponds, fighting flies and mosquitoes, and have made little of such things as being of no consequence, when engaging on surveys, are often the first to make a noise about them.

Those who make light of hardships are often those who have not experienced any, and are less likely to endure them.

We do not believe in rules to govern survey parties in the field, nor do we believe when engaging men to have them sign an agreement or contract, but think that in the future, as in the past, it will be better for each survey party to be "a law unto itself;" and that the surveyor's own *ipse dixit* be his authority for promulgating such laws as he may think fit. It is sufficient that men be guaranteed board and pay; in return for which, whatever there is to do, they should do it with all their might.

We would, therefore, recommend that, although the Regulations pretty well cover the duties of the various members of a survey party, no action should be taken regarding them by the Association.

JOHN McLATCHIE,
Chairman.

REPORT OF STANDING COMMITTEE ON NATURAL HISTORY AND GEOLOGY.

To the President and Members of the Association
of Dominion Land Surveyors.

Gentlemen,

Your Committee beg to report as follows:—

(1) Some attempt was made last Spring to enlist the various Dominion Land Surveyors in the Government employ, to make small collections of Natural History objects in the various localities where they were working, but as far as we are aware with only partial results.

(2) Since our meeting Mr. W. Ogilvie, D. L. S., one of your own members, and Mr. McConnell, of the Geological Survey, have returned from their explorations in the Arctic regions. Though these gentlemen did excellent service in every other branch, their Natural History collections were very meagre.

(3) The cause of this is not far to seek, and it would be unfair to these gentlemen not to state it. Natural History investigations were not included in the scope of their work, and their time and means were fully employed in other spheres of labor.

(4) Mr. J. M. Macoun accompanied Mr. Fawcett's party to the Athabasca and English River districts as naturalist; but having to perform the work of an assistant as well as naturalist, the results obtained were not so valuable as they would have been if his whole time had been devoted to Natural History work.

(5) I am happy to say that all the members of the Association were not neglectful of their opportunities, and I have much pleasure in mentioning the name of Mr. G.E. McMartin, who procured a fine specimen of the Rocky Mountain Long-eared Rat at Pincher Creek, and another of the Acadian Owl from St. Andrews, near Montreal.

In conclusion, allow me to express the hope that after the explanations of this evening, numerous gentlemen will emulate the example of Mr. McMartin, and send us numerous fine specimens next year.

Signed on behalf of the Committee.

JOHN MACOUN,
Chairman.

REPORT OF STANDING COMMITTEE ON PERMANENT MARKING OF SURVEYS.

> Man's life is but a surveying bout,
> And he's best engineer
> Whose perfect transit ne'er is out,
> Whose plan and lines are clear.
>
> OLD POEM.

With regard to carrying out the suggestions in the paper "on the permanent marking of public Surveys in the field," published in the Report of the D. L. S. Association, in March of the year 1888, the undersigned would observe:

That there are two points which seem to demand special consideration: 1st. By what means can Surveys be marked in the field, so as to perpetuate them; 2nd. How can the results of those Surveys be published in a concise and convenient form, so as easily to give whatever information can be derived from them.

The plough in the field, fire in the bush, are powerful agents for the destruction of timber-posts. Trees are becoming too scarce to be spared for landmarks, and but for hard fighting with the fire every season, they would be even scarcer. Maps, to give accurate information, must be on a scale so large as to forbid their being published. Field notes are also difficult and expensive to publish, and occupy a good deal of space. If then Surveys are to be made permanent, and the information they furnish is to be given in such shape as to be easily packed away for future use, and yet to be always at hand, available for whoever wants it, there will have to be a departure from the wooden post and inscribed tree, and there must be some additional record of the work besides the usual plan and the report accompanying it. What then is to be substituted for the discarded landmarks, and what better method of recording shall we adopt?

It is hoped the accompanying table of co-ordinates, illustrated by a diagram of an imaginary Survey, will afford a satisfactory answer. Such a table is easily published, one page of a "blue book" would give enough for an extent of many miles. The diagram is nicely illustrative. A township plan showing the transit line of a Railway Survey being at hand, was taken advantage of, and a few hypothetical notes were added. A writer in one of the "exchanges" says: "if you leave plenty of marks, you have the Contractor (or whoever comes to disturb the Survey lines) by the throat, the lines can be restored if necessary." It is presumed the *modus operandi* is obvious. Lot corners, creeks, houses, intersections of roads, serve for points of reference, and though some may be lost, enough will remain to make the survey permanent.

In an extensive exploratory Survey like that of the Ottawa Ship Canal, it would be difficult to give precise rules—the Surveyor would have to do the best he could. Rocks in remarkable places, as for instance at the head of an Island, might be marked. Iron posts such as are used in the North-West would serve well for mile posts. They are light, imperishable, and useless for any other purpose, "Lo the poor Indian" lets them alone, so the chances in favor of their permanency are good.

It is unfortunate that the services of Messrs. Webb and Dumais, who were appointed with the undersigned to act as a Committee, could not be obtained. This unaided effort to meet the wishes of the Association necessarily falls very far short of what might be expected from the better judgment and experience of those gentlemen; but it must be either this or nothing, and it is hoped its defects will be viewed with leniency. The endeavor is to show that Surveys may be made permanent at a trifling additional expense, and that the information forthcoming from them can be conveniently and concisely given, in a great measure if not entirely, independent of a map.

Submitted with deference by

S. L. BRABAZON,
Chairman.

PORTAGE DU FORT, 1st Dec., 1888.

P. S.—Since the above was written, the courses and distances of the transit line and the co-ordinates of the initial point of each course have been added to the table before mentioned. It is scarcely necessary to say that as long as one recorded mark can be found, any other can be established by means of it. Corners of lots, in a settled country, may be regarded as permanent marks, conflicting interests tending to preserve them. The data are more than sufficient for the utilization and permanency of the Survey, but the work would be more complete and valuable if permanent bench marks had been made and were recorded.

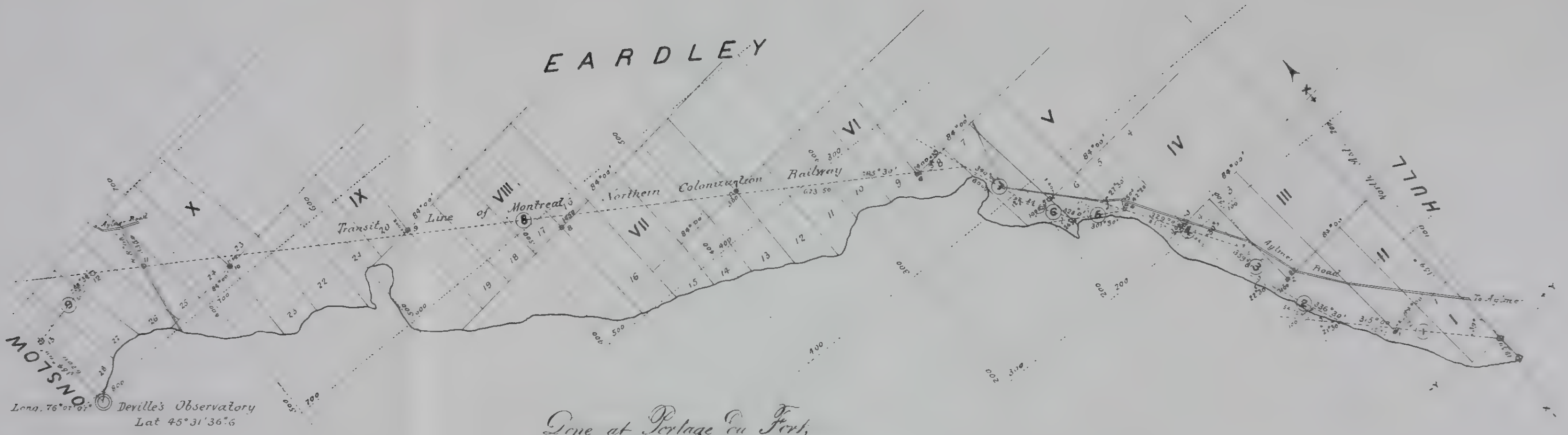
TABLE of co-ordinates of certain points in the Township of Eardley, County of Ottawa, Que., determined by the survey of the Montreal Northern Colonization Railway, the axis of X being the meridian, and that of Y a line perpendicular thereto.

	Co-ordinates.	
	X.	Y.
Origin of co-ordinates on E outline of Eardley 19.5 chs. from S.E. boundary of Township on the bank of the River Ottawa.....	0.00	0.00
S. Boundary post between Eardley and Hull	—19.50	+2.00
1 S. W. corner of Lot 2, R. II.............	55.00	—58.50
2 S. W. corner of 3, R. III, 9 chs. W. of Aylmer Road........................	131.50	94.50
3 S. E. corner of 5, IV, 4 chs. W. of Aylmer Road..............................	208.50	128.40
4 S. W. corner of stone foundation of M. N's dwelling house on Aylmer road.........	243.75	150.00
6 S. W. corner of 8, VI..................	283.00	191.00
7 S. E. corner of 13, VII................	427.00	361.00
8 S. E. corner of 17, VIII....	484.00	474.00
9 S. E. corner of 20, IX..................	553.00	564.50
10 S. W. corner of 23, X..................	613.50	676.50
11 Intersection of transit line with E. fence of road 33·50 chs. southerly from Aylmer road	650.00	723.50

	Co-ordinates. X.	Y.
12 Rock marked with a cross thus +.........	670.00	755.50
13 Intersection of transit line with W. outline, 62 chs. from S. W. corner......	654.60	873.30
14 S. W. corner of Eardley, Latitude 45°, 31′, 36″.6 as determined by Deville....	593.50	806.35

No. of Line.	Transit Line. Course.	Distance chains.	Initial Point. X.	Y.
1	315° 00′	115 75................	0.00	0.00
2	336 30	54 50................	81.50	83.00
3	359 00	41 00................	130.00	105.60
4	329 00	85 50................	171.00	107.50
5	300 30	37 95................	243.50	155.50
6	328 00	26 00................	261.50	187.50
7	340 00	61 50................	283.00	202.00
8	305 30	623 50................	340.00	226.00
9	258 30	60 00.........	670.00	755.00

Convergence of Meridians say 1′ 4″ p. 100 chains.



Done at Portage du Fort,
on the 1st of December 1888.
J. L. Brabazon, D.L.S.
To accompany report of even date.

REPORT OF STANDING COMMITTEE ON PHOTO-TOPOGRAPHY AS APPLIED TO TOPOGRAPHICAL SURVEYING.

Mr. President and Gentlemen,

I have the honor to present the Report of your Committee on "Photography as applied to Topographical Surveying."

In preparing our Report we have thought it best not to attempt a detailed statement and proof of all the constructions or problems involved, as we understand that a work on the subject by E. Deville, Esq., Surveyor-General, is now in press, and, as he is the father of the science (if I may so term it) in this country, it will necessarily be much more complete than anything we could hope to offer.

We will therefore confine this report to a short sketch of the history of the work, the method used in the field, and the explanation of one or two of the problems solved in plotting the topography from photographs.

The field work in this branch of our profession is very laborious, involving suffering from thirst, hunger, cold and extreme physical fatigue.

Every ascent and descent, together with the taking of the necessary photos and reading of angles, is performed in the same day; which sometimes necessitates from twelve to fifteen hours of the most severe physical exercise.

At the commencement of the work, on good climbing, a progress of 800 feet in elevation per hour is about the average; but toward the end of the season, when all superfluous flesh has disappeared, and a man's muscles are as hard as nails, a better rate is made, and sometimes 2000 feet per hour is accomplished.

Again, a "snag" may present itself, and 400 feet per hour is good time.

These are not all the hardships.

The great mental agony, caused by driving pack horses, can only be known to those who have tried it. If any man is in the habit of using "emphatic" language and wishes to cure himself, let him take half-a-dozen pack horses and start into the mountains.

In two hours he will have found out the ineffectiveness and foolishness of all the "cuss" words in the English vocabulary, and the *utter* insufficiency of all language to do justice to the occasion.

The application of photography to topographical work is no new idea, but has been tried more or less in several European countries during the present century; but has *not* been developed and used in *any* country to the extent practised and contemplated in Canada.

In the spring of 1887 the Department of the Interior sent out two parties under special instructions from the Surveyor-General, who had developed the system of "Photogrammetry," and written a pamphlet on the subject for their guidance.

Both parties were equipped with cameras and prismatic transits, and were ordered to the Rocky Mountains for the purpose of carrying on a Topographical Survey; one party under J. J. McArthur, D.L.S., working in the summit range of the Rockies proper, and the other, in charge of the writer, in the Coast Range.

The astronomical traverse of the Canadian Pacific Railway was used as a base, and from this a triangulation was extended back into the mountains, the stations occupied being generally the highest peaks. The instruments used for triangulation purposes were 3½ inch prismatic transits reading to single minutes by two verniers.

Signals were sometimes used, but more often the readings were taken on the peaks themselves.

The height of stations was determined by reading angles of elevation or depression from station to station, allowance being made in the calculations for curvature of the earth and refraction.

The cameras used were "Eastman Detective" with drop shutters, using roll films. With these a series of photographs embracing the surrounding country were taken, by time exposure, from each of the instrument stations occupied.

From these photographs the topography was laid down on the plan. The work during that year was very largely experimental, as nothing of the kind had been attempted here before.

Owing to the unsuitability of the roll films, and delay from smoke the result was not as good as hoped for, but was sufficiently good to show the feasibility of the work, and the great advantage in cost over any other method. We consider that to make as accurate a survey of the same country by the ordinary methods would cost from ten to fifteen times as much; while much of it could be done by no other method, of which we have knowledge, than photography.

Accordingly, in the spring of 1888, the two parties were again sent out: one to the summit range of the Rockies in the vicinity of Banff, and the other to the Crow's Nest Pass. The same transits were used, but English cameras, with Dallmeyer lenses, using glass plates, were substituted for the Eastman cameras and roll films. The work was carried on in much the same manner as the preceding year, with the exception that, in the triangulation, all angles were read twice on signals, the sides of the primary triangles varying from seven to twelve miles; as before, photographs of the surrounding country were taken from all instrument stations..

The results were satisfactory, the photographs turning out well, and about seven hundred square miles of the country being covered. No developing was done in the field, all negatives being securely boxed and forwarded to Ottawa, where they were developed and printed by Mr. H. N. Topley, photographer to the Department of the Interior.

This entailed a very large amount of work, as about six hundred and seventy-five plates were exposed. The negatives were all enlarged to four times the original area by the "Bromide" process, on the principle that plotting with a protractor of ten inches radius is more accurate than with one of five.

This brings us to the application of the photographs to topography.

We will state at the outset that the cameras were furnished with levels to insure the verticality of the plates, and the focal length was constant.

Now a photograph, apart from small errors arising from the lens, is a true perspective.

In perspective drawing we have the *object* or its *plan* to produce the *perspective;* here we have the *perspective* to produce the *plan.* So, if to the perspective we apply the reverse of the problems used in forming it, we have the means of making our plan.

To do this, we must know the focal length of the camera, which is the distance of the picture plane from the station point, and we must also know the distances apart and relative positions of the different stations.

This latter is found by plotting the triangulation, and the focal length is found by a simple process already described in works on the subject.

In connection with the taking of each view, zenith distances and azimuths are measured with the transit to two or more peaks appearing in that view. As we know the focal length, by a simple construction, the distance of the peaks above or below the horizontal plane can be laid off on the photograph on its scale, and the horizon or horizontal line drawn in its proper position.

The position of the centre of vision or point of sight on the horizontal line is found at the same time as the focal length; and the trace of the principal plane, in which it lies, is drawn on the photograph from marks, photographed in each view from fixed marks on the plate holder, whose positions in regard to the principal plane are known. The intersection of the trace of the principal plane and horizontal line is the centre of vision or point of sight.

In our work, the projection on the plan of a straight line in space, through the station point and point of sight, is called the principal or centre line.

It may be projected on the plan in the following manner :—

From the azimuths measured with the transit, we know the direction from the station of some one of the peaks appearing in the photograph. A line in this direction is drawn on the plan. Next measure on the photo, with a pair of dividers, the distance of the perspective of the peak from the trace of the principal plane.

By using a scale of one hundred equal parts, the focal length and the distance measured on the photo, the natural tangent of the angular distance between the peak and point of sight may be found, and the principal or centre line projected on the plan.

Or, on the plan, find by trial a point at the distance of the focal length from the station, and, at the same time, at the distance taken from the photo (measured at right angles to the first distance) from the line drawn in the direction of the peak.

The point thus found is the projection on the plan of the point of sight.

Through this point draw a line from the station and also a line perpendicular to the first. These are respectively the projections on the plan of the principal and picture planes, and are the *centre line* and *picture line.*

Suppose the same operation gone through with a photo taken from an adjacent station, so that its centre line will intersect that of the first at an angle of, say, about 60°.

It is evident that many of the same points appear in both photos. Now if a number of these points be selected, and their distances from the trace of the principal plane laid off on their respective picture lines, then if lines be drawn through corresponding points from their respective stations, their intersections *must* be the projection on the plan of the several points.

The points thus established may be points on the crest of a ridge or spur, on a mountain side or on the bed of a stream. By using their projections on the principal plane, their distances from the picture plane and above or below the horizontal line, we obtain, graphically, their elevations in relation to the stations from which they were located.

The fact is thus revealed, that so far the application resolves itself into a graphical solution of triangles.

We can thus fix any number of points, and then have an accurate guide for sketching in contours, with the additional advantage of a photograph of the country before us.

The matter does not end here, however.

Suppose the points already laid down mark the direction of the crest of a ridge or the slope of a spur, and, as is most probably the case, that it is the same for some distance. Other laws of perspective being used as a basis, we are able to lay down on the plan the points of intersection of the several contour planes with the crest of that ridge of spur.

One law used in this problem is "All lines which in the object are parallel vanish in the same point."

The direction of the ridge, in regard to the centre line of the photo in which it appears, is obtained from the plan by aid of a protractor.

Now, suppose a vertical plane, cutting the contour planes, is passed through the length of the line marking the crest of the ridge. It is evident that the intersections of this plane with the contour planes are horizontal lines lying in the direction of the ridge, and therefore parallel; then, by the rule given above, they all vanish in the same point.

We will find this point.

Another law of perspective tells us that all horizontal lines, not parallel to the picture plane, vanish in the horizontal line; therefore the point in which the lines vanish is in the horizontal line.

The projection on the plan of the vanishing point is then found by drawing a line from the station point parallel to the direction of the ridge; its intersection with the picture line is the projection of the vanishing point sought.

We are now dealing with vertical distances, and must consider our construction in elevation, and will suppose the vanishing point projected on the horizontal line. The next step is to find the space on the photo which represents the distance apart of the contour planes.

Suppose a vertical plane passed through the station point and some one of the points (which we will call A) located on the crest of the ridge.

The intersection of this plane with the vertical plane passed through the crest of the ridge is a perpendicular line, as is also its intersection with the picture plane; and, from the nature of perspective, this last perpendicular is the perspective of the first, and must pass through the perspective of the point A (which we call A^1).

Now, if the perpendicular through A be divided into spaces equal to the distances apart of the contour planes on the scale of the plan, and in such a manner that the point A occupy its proper height in regard to a contour plane; then if straight lines be drawn from the station point to each of the divisions on the perpendicular through A, it is evident that their points of intersection with the perpendicular through A^1 will mark, on that perpendicular, the distances apart of the contour planes on the scale of the photo.

These points on the perpendicular through A^1 are evidently the perspective of the points on the perpendicular through A; we therefore have the perspective of two points in each of the lines, found by passing a vertical plane through the crest of the ridge, and cutting the contour planes, viz. :—the vanishing point and the points just found on the photo.

Now, if from the vanishing point we draw a line through any one of the points last found, it is evident that its intersection with the perspective of the crest of the ridge is the perspective of the point of intersection of the contour plane in which it lies. The above is the explanation of so much of the problem; but, as everything was considered in space, it is evident that a slightly different method must be adopted to make practical use of it.

It is done by considering the vertical plane, passed through the station point and A, as revolved about the perpendicular through A^1 until it coincides with the picture plane. Both planes are then revolved about the horizontal line, until they coincide with the horizontal plane—which may be considered as the surface of the drawing board.

The station point and point A appear on opposite sides of the point A^1 at their proper distances from it. The perpendicular through A^1 may then be divided, as before, by drawing lines from the station point through the points of intersection of the contour planes with the perpendicular through A.

Then from the vanishing point draw lines through the points of division on the perpendicular through A^1. The intersections of these lines with the perspective of the crest of the ridge are, as before, perspectives of the points of intersection of the contour planes with the crest of that ridge.

Having found these intersections, we next mark off their distances from the trace of the principal plane on a slip of paper, or measure them with dividers, and transfer them to their respective picture lines; lines being drawn through these points from their respective stations, their intersections with the line marking the crest of the ridge are the projections on the plan of the intersections of the several contour planes with that ridge, and the problem is solved.

The reason for going at such length into the above problem is, that we know of no book, yet given to the public, in which it appears.

The solution of another problem enables us to lay down on the plan an accurate traverse of any lake or stream, the height of the station from which the photo was taken above the lake or stream being known.

There are many other problems, but those mentioned above are the ones most often used, and time and space prevent further trespass on your patience.

W. S. DREWRY,
Chairman.

OTTAWA, Feb. 21, 1889.

REPORT OF COMMITTEE ON TOPOGRAPHICAL SURVEYING.

TO THE PRESIDENT AND MEMBERS OF THE ASSOCIATION
OF DOMINION LAND SURVEYORS.

GENTLEMEN,

As Chairman of the Committee on "Topographical Surveying," a Report is expected from me.

Being at present not actively engaged in that class of work, my Report will not be confined to any particular field of action, but will treat the subject in its widest scope.

Prefatorily I may state that we have no organized "Topographical Surveying" in Canada. The result of "Topographical Surveying" is a "Topographical Survey."

Let us see what a Topographical Survey means. It means that the face of the country has been accurately delineated in both horizontal and vertical measurements; it means that all the natural features of the country are accurately shown and drawn on maps; it means that the geologist is in possession of a plan, whereon he can with confidence show the accurate position of rock formations, deposits of economic minerals, can elaborate geological maps for the information of the public and those especially interested in the mineral industries—that industry to which, to a great extent, the future greatness and development of Canada depends; it means that the naturalist can more intelligently study the fauna and flora of the country. Is not agriculture to a large extent a function of the Topography of the country? Will any one attempt to deny that our lately organized Experimental Farm at Ottawa, with branches in the various provinces, would not reap vast benefits in solving many problems in agriculture, horticulture, and arboriculture, were a topographical survey extant? It means that the engineer is afforded a reliable basis for computing the available basin from which to draw water supply, or where he can the most advantageously and economically project a railway; it means that the meteorologist will be assisted in solving the mysteries of atmospheric phenomena, especially of local storms.

It means in fine that every citizen of our beloved Canada would be benefited directly or indirectly.

Probably to no one is the value of a topographical survey, from a pecuniary point of view, so apparent and so directly valuable as to a person interested or engaged in mining operations. The elaborate plates of the mining regions in Pennsylvania and Colorado can bear witness to this.

We have not a great deal of scientific work prosecuted by the Government, and the Nation has not as yet learned to appreciate the results of national scientific work. I know that some people have the idea that we live in too "practical" an age to spend time and money in pursuit of "Science," which to them is synonymous with something "mysterious" and "impracticable."

The object of Science is the discovery of truth, and the practical man applies that discovery.

When a new important invention by Mr. Ingenuity is flashed over the world, who knows on how many men's brains the inventor has fed, until his skill could evolve that self-same invention, how many years of toil and labor had been spent in laboratory and field to furnish the necessary "truths" to make such invention possible.

As Darwin, Haeckel and Huxley have given us the theory of Evolution in life, so there is an evolution and development in the appliances for the amelioration of the condition of man.

Science and its practical application must go hand in hand, otherwise neither one bears its true usefulness.

What position would Germany occupy to-day in spite of the unification in 1871, were she not pre-eminently a nation of scientific attainments? There is not an industry in the Empire that does not keenly observe the researches of the devotees of Science, and quickly absorb any new discovery, and wisely does the Government encourage both.

Lest the subject become trite by further illustrations of the importance of a scientific basis for all work, I will revert to the subject proper.

To every one familiar with the subject at all, it must be patent that a topographical survey attains its full value only when it is based on a geodetic survey. As we have a special committee for that branch, I will leave any further reference to it for the Chairman thereof to report thereon.

Two questions present themselves to my mind in connection with a topographical survey: The first is what organization is to perform it, and secondly where shall the survey begin.

That such a survey must be a national undertaking, and hence under federal patronage, is certain. That at its inception it must be laid down in broad lines for future development is also evident, and furthermore that from the beginning the work be prosecuted with the thoroughness attainable by modern and refined methods.

Such survey should not be prosecuted as an isolated work, but should be in sympathy with allied surveys, so that they combined will supplement each other and blend into one harmonious whole, creditable as a work of Science, and beneficial to the people of Canada who pay for its execution.

I intentionally leave my two questions unanswered, in the hope that they may provoke discussion.

Of the methods of survey to be pursued I will leave for future consideration.

To me it would have been interesting to have dwelt somewhat on "Photogrammetry," an art which has of late years been extensively developed in Italy and Germany; but as our Association has a Committee on that subject, the prerogative of its Chairman is respected.

Before closing I take pleasure in giving the following extracts from Vol. I. of the Geological Survey of New Jersey, just issued:

" And now that the Geodetic and Topographical Surveys of the "State are completed, the final report of the Geography of New "Jersey is presented in this volume. At the beginning of the Sur-"vey no such work as is here given entered into our plans. But as "the successive reports appeared, and as the attempts at descriptive "Geology were made, it became apparent that for the study and "preparation of useful geological reports, it was necessary to have "accurate maps—maps which would show the location of all the "important geographical points, and also the outlines and elevations "of the hills and valleys, and their heights above the sea level. "There were no such maps of New Jersey in existence, nor indeed "of any others of the United States. In the first attempts to prepare such, it was considered doubtful whether the expense could "properly be incurred; but when they were issued, the approval they "met, both from the people and the Legislature, gave assurance "they supplied a felt want. . . . . . . The Geodetic Survey of "the State was made, in order to fix accurately the latitudes and "longitudes of points in the various parts of the State. They were "necessary for furnishing correctly located points about which the "Topographical Surveys could be arranged and located."

In conclusion, it is to be hoped that "Topographical Surveying" will become a permanent feature of the work prosecuted by the Department of the Interior.

May this meagre report on so extensive and so important a subject meet with your approbation.

OTTO J. KLOTZ,
Chairman.

OTTAWA, Feb. 21, 1889.

REPORT OF SPECIAL COMMITTEE ON GEODETIC SURVEY FOR CANADA.

OTTAWA, 16th February, 1889.

TO THE PRESIDENT AND MEMBERS OF THE ASSOCIATION
OF DOMINION LAND SURVEYORS,

GENTLEMEN,

The committee appointed at the last annual meeting of the Association for the purpose of taking "such necessary steps as they deem advisable, in order to bring before the Government the urgent necessity of a Geodetic Survey of the Dominion," beg to report as follows:—

The committee prepared a memorandum on the subject, which was included in the Annual Report.

Furthermore, copies of the Memorandum were sent to every member of the House of Commons and Senate, and to all the Deputy Ministers.

The committee also communicated with a number of persons in the Dominion, of high professional attainments and competent to express opinions on the subject that have weight. In every instance the efforts of the committee as expressed in the Memorandum were highly approved of by these gentlemen, and their services offered to help to further the inception of the Geodetic Survey.

The committee has also brought the matter before the Government and are pleased to be able to report that the Government favorably entertains the Memorandum presented.

This is a brief outline of the work of the committee since the last annual meeting of the Association. In conclusion the committee beg to suggest that any further efforts that are to be made in this matter be assumed and done by the Standing Committee on Geodetic Surveying.

All of which is respectfully submitted.

OTTO J. KLOTZ,
Chairman.

REPORT OF COMMITTEE ON REDUCED RAILWAY FARES.

OTTAWA, February 19th, 1889.

MR. PRESIDENT AND GENTLEMEN OF THE ASSOCIATION
OF DOMINION LAND SURVEYORS,

Your Committee to enquire and confer with the different Railway Companies with regard to allowing Dominion Land Surveyors reduced rates to and from the Association meetings, beg to report as follows:

The General Passenger Agents of the Grand Trunk Railway and the Eastern and Western Divisions of the Canadian Pacific Railway were communicated with to find out what could be done in the matter. In reply, memos. regarding Reduced Fares to Conventions, etc., were received from the Grand Trunk and Eastern Division of the C.P.R., which set forth that Reduced Rates would be granted to Delegates to our Association Meeting at the rate of one fare and one-third for return trip, provided there were twenty-five or more Delegates attending the said meeting who had paid Railway fares; if less than twenty-five, at one and two-thirds, which last amounts to the ordinary return rates.

In order to take advantage of these reduced rates it is necessary that a certificate, on a form supplied by the Companies, should be signed by the local agent who issues the ticket to the place of meeting, and that the Secretary-Treasurer of the Association should certify upon the back of the same form the number of delegates attending the meeting. Further communication elicited the fact that it is not necessary that twenty-five delegates should travel over the same road or that certificates should be held by that number;

all that is required to entitle holders of certificates to the reduction is that twenty-five delegates should have paid railway fares.

The General Passenger Agent of the Western Division of the C.P.R. made a similar proposition, but your Committee could not take advantage of the same as it was on the condition that twenty-five delegates should travel over that road West of Port Arthur, and no such number being available, arrangements could not be made.

Your Committee instructed the Secretary-Treasurer to obtain the necessary certificates and to transmit one to each member likely to make use of a railroad to reach the place of meeting, and this we understand has been done, as also to other parties applying for them.

Further information may be obtained by referring to the papers, in connection with this matter, on file with the Secretary-Treasurer. In conclusion your Committee would suggest that in future years a similar privilege be sought from the Intercolonial Railway, as also better terms from the Western Division of the C.P.R.

All of which is respectfully submitted.

Signed on behalf of the Committee.

G. B. ABREY,
Chairman.

REPORT OF SCRUTINEERS OF BALLOTS.

Feb. 21st, 1889.

To the President and Members of the Dominion Land Surveyors' Association,

We the undersigned scrutineers appointed to examine and count the ballots sent in for the election of officers for this Association for the current year, beg to report that we have performed that duty, and find the votes to be as follows:

Total No. of ballots received—45.

Votes for President.

J. S. Dennis	21 votes.	
E. J. Rainboth	14 "	
G. B. Abrey	9 "	
		44

1 Blank.

For Vice-President.

William Ogilvie	27 votes.	
John McAree	7 "	
Thos. Drummond	6 "	
I. J. Dufresne	5 "	
		45

FOR SECRETARY-TREASURER.

A. O. Wheeler	44	votes.
S. Bray	1	“
R. Rauscher	0	“
	——	45

FOR EXECUTIVE COMMITTEE.

Otto J. Klotz	35	votes.
Thos. Fawcett	25	“
John McLatchie	19	“
G. C. Rainboth	18	“
T. D. Green	10	“
G. E. McMartin	8	“
A. C. Talbot	8	“
Thos. Breen	7	“
C. A. Biggar	4	“

FOR AUDITORS.

J. J. McArthur	20	votes.
W. S. Drewry	14	“
F. Driscoll	12	“
J A. Belleau	10	“

EDGAR BRAY,
J. FREDERICK SNOW,
WM. CRAWFORD.

Received and adopted.

JOHN McAREE,
Vice-President.

NOTICES.

SEVENTH ANNUAL MEETING.

The Seventh Annual General Meeting of the Association will be held at Ottawa, commencing on the third Tuesday in February, 1890.

It is earnestly hoped by the Executive Committee that members will do all in their power to assist in furnishing a suitable programme for the occasion, both by their own individual efforts, and by lending any assistance possible to the several Standing Committees working in the interests of the profession.

Professional information of any kind, whether sought or offered, will be duly reported upon, if referred to the Chairman of the Committee to which the same relates, or if forwarded to the Secretary-Treasurer of the Association, will be transmitted to its proper Committee.

SECRETARY-TREASURER.

NATURAL HISTORY AND GEOLOGY.

Members are specially invited to read Professor Macoun's Report on Natural History and to note the request contained therein.

Year after year the Professor has appeared at the Annual General Meeting and brought forward a similar request in more or less strong terms, fully realizing that the surveyor's opportunities are more numerous than those vouchsafed to the general man.

As Professor Macoun takes a deep interest in the Association and does all in his power to forward its ends, it is but fair that in return his request should be attended to, and that members of the Association in particular, and of the Profession generally, should make a strong effort to forward at least one specimen of Natural History or Botany during the year. I may say, from my personal knowledge of the Professor, that "all is fish that comes to his net," and even if the contribution be not valuable, the intention will be appreciated just as highly.

Dr. Bell, Assistant Director of the Geological Survey, has several times made a similar request on behalf of Geology and Mineralogy.

SECRETARY-TREASURER.

PUBLICATION.

It is proposed in future editions of the Annual Report, to set aside a few pages, under the title of " Member's Record," to contain in a few lines a synopsis of the work each member has been engaged upon for the past year.

It has been suggested that a Record of this kind would have several advantages: 1st. It would be an advertisement of each man's specialty in professional work. 2nd. It would enable a comparative stranger to find the man he wanted to do a certain kind of work in a certain locality. 3rd. It would make our Reports of additional interest to one another, for, though "curiosity" has, since time immemorial, been delegated to woman, there are few men, *even* surveyors, but would like to know what their neighbours have been doing. 4th. Each man whose name appeared in such Record would feel that to a certain extent he had a proprietorship in the Annual Report, and was therefore more closely connected with his brother members.

This notice has been inserted, in order to bring the suggestion before the members and obtain their opinions of the same; also as to whether they would be willing to contribute to such Record.

T. D. GREEN,
Chairman Publication Committee.

ELECTION OF OFFICERS.

For the first time since the inauguration of the Association, the Officers for the ensuing year were elected by general ballot. Out of sixty-five members, entitled to vote, forty-five recorded their ballots. This may be considered as a very fair proportion for an experiment, and it is hoped that at the coming election the members will exercise still more freely their privilege, and, that every one who has a vote, will cast it, and so by taking an active interest in the working machinery of the Association, make it a powerful combination to protect the rights and prerogatives of the Profession.

J. S. DENNIS,
President.

PROBLEMS AND SOLUTIONS.

SUBDIVISION OF A QUADRILATERAL FIGURE.

To divide a quadrilateral figure into any number of parts by lines parallel to one of the sides, the sides and angles of the quadrilateral being known.

Fig. 1.

Let the area of the first part be to the remainder as m to n.

Let EG be the required line.

Draw AQ parallel to BD, and let the angle EAQ be called θ, then $\theta=(A+B-180^\circ)$ and $EG=EQ+QG=EQ+AB$.

Also, $EQ:AE::\text{Sin }\theta:\text{Sin }AQE$, but $AQE=EGB=(180^\circ-B)$

$$\therefore EQ:AE::\text{Sin }\theta:\text{Sin }B$$

$$\therefore EQ=\frac{AE\times\text{Sin }\theta}{\text{Sin }B}$$

$$\therefore EG=\frac{AE\times\text{Sin }\theta}{\text{Sin }B}+AB$$

From A draw AP perpendicular to EG, then $AP=AE\times\text{Sin }AEP=AE\times\text{Sin }(180-\text{A})=AE\text{ Sin }A$.

Now area of $ABGE=\dfrac{AB+EG}{2}\times AP=$

$$=\frac{AB+AB+\dfrac{AE\text{ Sin }\theta}{\text{Sin }B}}{2}\times AE\times\text{Sin }A$$

$$=\frac{2AB\times\text{Sin }B\times AE\times\text{Sin }A\ +\ AE^2\text{ Sin }\theta\times\text{Sin }A}{2\text{ Sin }B}$$

but area $ABGE$:area $ABDC::m:(m+n)$

$$\therefore ABGE=\frac{m\times ABDC}{m+n}$$

$$\therefore\frac{2AB\times\text{Sin }B\times AE\text{ Sin }A+AE^2\times\text{Sin }\theta\times\text{Sin }A}{2\text{ Sin }B}=$$

$$=\frac{m}{m+n}\left\{\tfrac{1}{2}AC\times AB\times\text{Sin }A+\tfrac{1}{2}BD\times DC\times\text{Sin }D\right\}$$

$$\therefore 2AB \times \text{Sin B} \times AE \text{ Sin A} + AE^2 \text{ Sin } \theta \times \text{Sin } A =$$

$$= \frac{2m \times \text{Sin } B}{m+n} \left\{ AC \times AB \times \text{Sin } A + BD \times DC \times \text{Sin } D \right\}$$

$$\therefore AE^2 + 2AE \times \frac{AB \text{ Sin } B}{\text{Sin } \theta} =$$

$$\frac{m}{m+n} \left\{ \frac{AB \text{ Sin } B \times AC}{\text{Sin } \theta} + \frac{BD \text{ Sin } B \times DC \times \text{Sin } D}{\text{Sin } A \times \text{Sin } \theta} \right\}$$

$$(1^\circ) \therefore AE = -\frac{AB \text{ Sin } B}{\text{Sin } \theta} \pm$$

$$\pm \sqrt{\frac{AB^2 \times \text{Sin}^2 B}{\text{Sin}^2 \theta} + \frac{m}{m+n} \left\{ \frac{AC \times AB \times \text{Sin } B}{\text{Sin } \theta} + \frac{BD. \text{ Sin } B \times CD \times \text{Sin } D}{\text{Sin } A \times \text{Sin } \theta} \right\}}$$

This formula though somewhat long does not require very much calulation, as the quantity $\frac{AB. \text{Sin B}}{\text{Sin } \theta}$ occurs three times.

If, for example, it be required to divide the quadrilateral into three equal parts, then $m : n :: 1 : 2$ and $\frac{m}{m+n} = \frac{1}{3}$

Then (2°) $AE = -\frac{AB \times \text{Sin } B}{\text{Sin } \theta} \pm$

$$\pm \sqrt{\frac{AB^2 \times \text{Sin}^2 B}{\text{Sin}^2 \theta} + \frac{AC \times AB \times \text{Sin } B}{3 \text{ Sin } \theta} + \frac{BD \times \text{Sin } B \times CD \text{ Sin } D}{3 \text{ Sin } A \times \text{Sin } \theta} \Bigg\}}$$

To find the next point, as *F*, the ratio of *ABHF* to the remainder would be used, and the length *AF* found as above.

To find the points *E* and *F* graphically. Let it be required to divide *ABDC* into three equal parts :—

Fig. 2.

First divide *ABDC* into three equal parts, in the usual manner, viz. :—

Draw *AJ* parallel to *BD*, divide *AJ* into three equal parts at *K* and *M*, and trisect *BD* at *L* and *N*, join *KC* and *MC;* then the figures *ABLKCA*, *CKLNMC* and *CMNDC* are equal; draw *KO* and *MP* parallel respectively to *LC* and *NC*, then join *LO* and *NP* and the figures *ABLO*, *OLNP* and *PNDC* are equal.

It remains now to draw lines *EG* and *FH* through *OL* and *PN* parallel to *AB*, and so as to make *ABGE*, *EGHF* and *FHDC* equal to each other.

See Figure 3. Let it be required to draw a line PN cutting LO in such a manner as to leave the area of $ABNP$ equal to that of $ABLO$. Let PN intersect LO at R.

Fig. 3.

Draw LO and OF parallel to AB, then if PN be the required line, the triangles OPR and LNR are equal; also the triangles LOQ and LOF being between the same parallels are proportional to their bases LQ and OF; also the triangles LOQ and ROP are similar, as are also the triangles OLF and RLN ∴—

(1°) $\frac{LOQ}{LOF} = \frac{LQ}{OF}$, also,

$ROP : LOQ :: PO^2 : OQ^2$ and $RLN : OLF :: LN^2 : LF^2$

∴ Since $ROP = RLN$, $\frac{LOQ \times PO^2}{OQ^2} = \frac{OLF \times LN^2}{LF^2}$ or

$\frac{LQO}{OLF} = \frac{LN^2 \times OQ^2}{LF^2 \times PO^2}$ ∴ from (1°) $\frac{LQ}{OF} = \frac{LN^2 \times OQ^2}{LF^2 \times PO^2}$ (4°)

but since the lines LQ, NP and FO are parallel,

$OQ : OP :: LF : NF$ ∴ $\frac{OQ^2}{OP^2} = \frac{LF^2}{NF^2}$ ∴ from (4°)

$$\frac{LQ}{OF} = \frac{LN^2}{LF^2} \times \frac{LF^2}{NF^2} = \frac{LN^2}{NF^2}$$

$$\therefore LN^2 = \frac{LQ}{OF} \times NF^2 = \frac{LQ}{OF} \times (LF - LN)^2$$

$$\therefore LN^2 = \frac{LQ}{OF} \times (LF^2 + LN^2 - 2LF \times LN)$$

$$\therefore LN^2 \left\{ 1 - \frac{LQ}{OF} \right\} + 2LN \times \frac{LQ \times LF}{OF} = \frac{LQ}{OF} \times LF^2$$

$$\therefore LN^2 \left\{ \frac{OF - LQ}{OF} \right\} + 2LN \times \frac{LQ \times LF}{OF} = \frac{LQ \times LF^2}{OF}$$

$$\therefore LN^2 \; (OF - LQ) + 2LN \times LQ \times LF = LQ \times LF^2$$

$$\therefore LN^2 + 2LN \times \frac{LQ \times LF}{OF - LQ} = \frac{LQ \times LF^2}{OF - LQ}$$

$$\therefore LN = \frac{-LQ \times LF}{OF - LQ} \pm \sqrt{\frac{LQ^2 \times LF^2}{(OF - LQ)^2} + \frac{LQ \times LF^2}{OF - LQ}}$$

$$\therefore LN = \frac{-LQ \times LF}{OF - LQ} \pm \sqrt{\frac{LF^2}{(OF - LQ)^2} \left\{ LQ^2 + LQ \times OF - LQ^2 \right\}}$$

$$\therefore LN = \frac{-LQ \times LF}{OF - LQ} \pm \frac{LF}{OF - LQ} \sqrt{LQ \times OF}$$

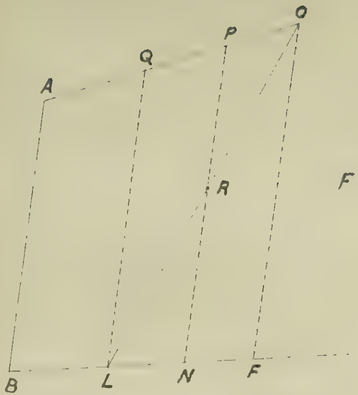


FIG. III

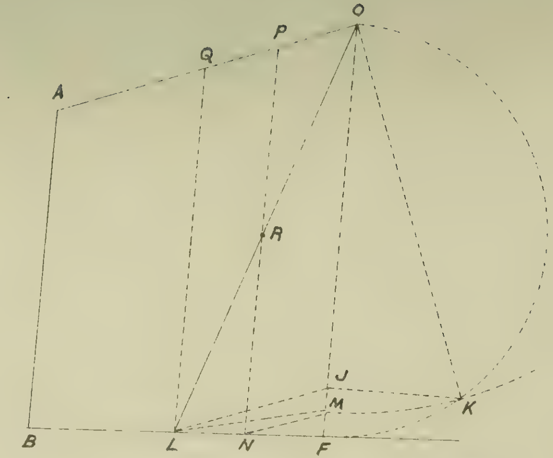


FIG. IV

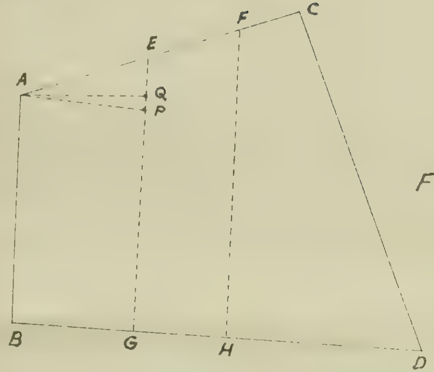


FIG. I

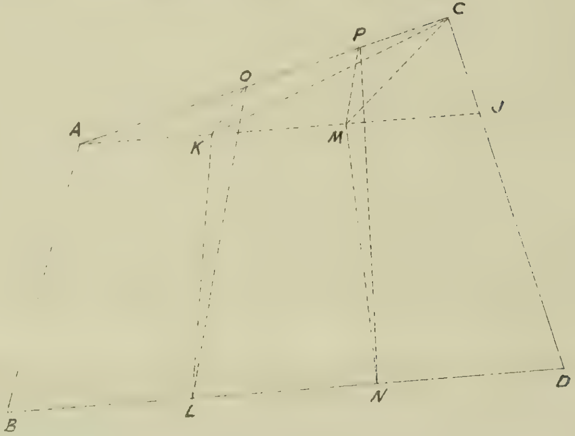
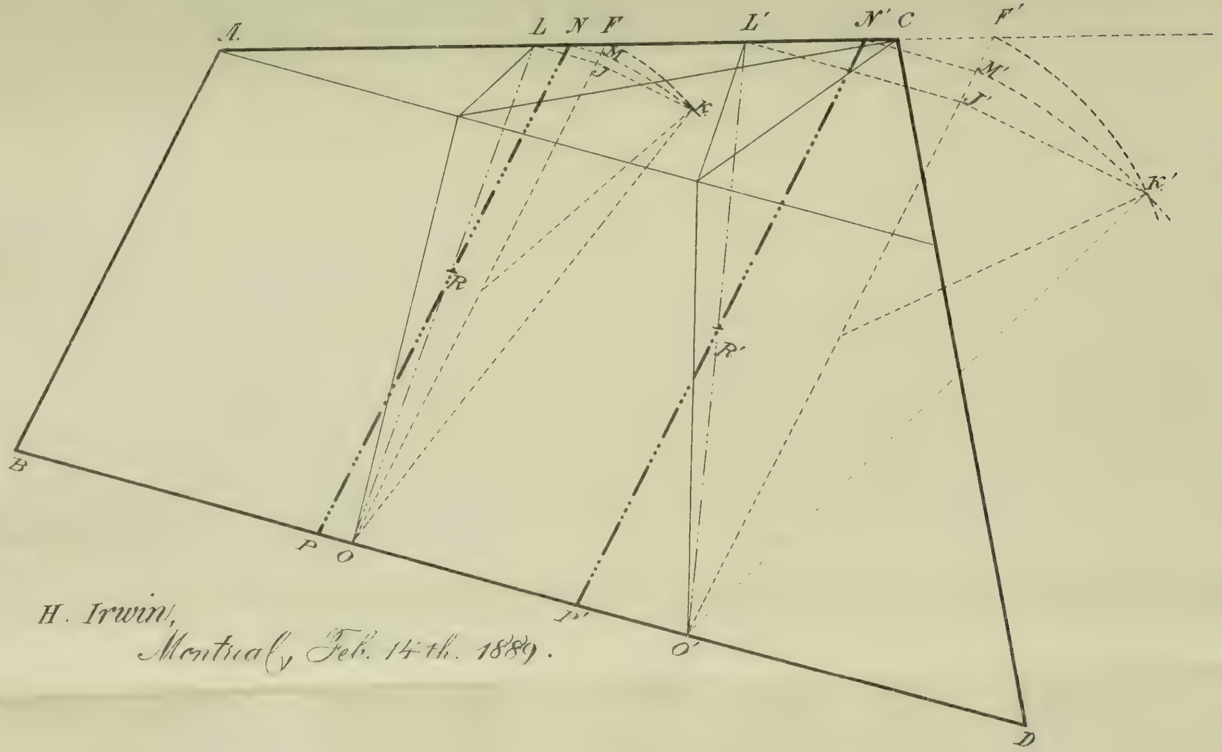


FIG. II

Diagram shewing Graphic method of dividing a Quadrilateral into any number of equal parts by lines parallel to one of its sides. $ABOL = LOO'L' = L'O'DC$ and $ABPN = NPN'P' = N'P'DC$; NP and $N'P'$ being parallel to AB.



H. Irwin,
Montreal, Feb. 14th. 1889.

$$\therefore LN = \frac{LF}{OF-LQ}\left\{-LQ \pm \sqrt{LQ \times OF}\right\} (6°)$$

From this equation the position of the point N can be determined graphically, as follows:—See Fig. 4.

Figure 4.

Having drawn LQ and OF parallel to AB, draw LJ parallel to AO, then $OJ=LQ \therefore OF-LQ=FJ;$ also, $LQ \times OF = OJ \times OF = OJ^2 + OJ \times JF$ (5°).

Now if a semicircle be described on OF, and from J, JK be drawn perpendicular to OF then $JK^2 = OJ \times JF \therefore$ from (5°) $LQ \times OF = OJ^2 + JK^2$ but $OK^2 = OJ^2 + JK^2 \therefore LQ \times OF = OK^2$

$$\therefore \sqrt{LQ \times OF = OK}$$

Now with O as centre and OK as radius, describe an arc of a circle cutting OF in M, then $OM = OK$

$\therefore OM = \sqrt{LQ \times OF,}$ we have, also,

$OF - LJ = FJ$ as above, and $LQ = OJ$

$$\therefore LN = \frac{LF}{FJ}\left\{\pm OK - OJ\right\} \text{ from } (6°)$$

$$\therefore LN = \frac{LF}{FJ}\left\{OM - OJ\right\} = \frac{LF}{FJ} \times JM$$

$$\therefore LN : LF :: JM : JF$$

The point N can therefore be found by drawing from M, MN parallel to LJ and the required dividing line, NP is drawn from N parallel to AB.

To recapitulate, the final graphic method is as follows:—See Figure 4. Draw OF parallel to AB, draw LJ parallel to AO, on OF describe a semi-circle, from J draw KJ perpendicular to OF, with O as centre and OK as radius cut off $OM = OK$, from M draw MN parallel to AO and, finally, from N draw the dividing line NP parallel to AB, the area $ABNP$ will then be equal to the area $ABLO$.

See accompanying Fig. 5 for a diagram drawn to scale.

H. IRWIN.

MONTREAL, 14th February, 1889.

PROBLEM.

Suppose there was a model of this planet, made, say, of pasteboard, and that part of it — the triangle ABC — having been injured, was removed. Required the radius of that sphere of similar material, from which a spherical triangle could be cut, to mend the injured spheroid that would most nearly coincide in curvature with the part of the spheroid that was removed.

S. L. BRABAZON.

N.B.—As the problem originally stands, BC is supposed to be nearly east and west, covering about 3° of Longitude—Latitude about 50°.

The solution, however, to be general, in terms of the semi-axis major (a) and the eccentricity (e) and the latitude. (See Fig.)

PROBLEM.

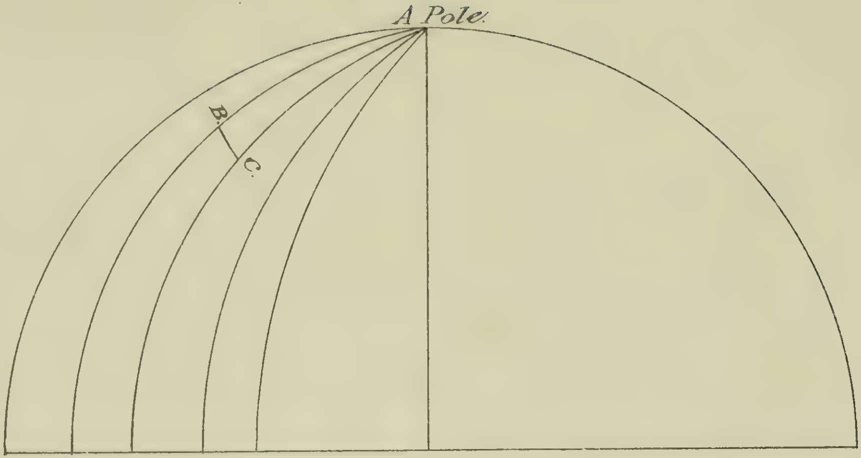
Suppose a triangulation of part of the St. Lawrence, where the course is easterly and westerly triangle, say three or four miles in average length of side, initial and terminal points say 150 miles apart; how would you obtain from such a triangulation the difference of Latitude and Longitude between the first and last stations?

Having regard in a spherical solution to use that sphere most nearly coincident in curvature with the terrestrial surface involved in the case.

Deduce formulæ for working, and illustrate by rough diagram or projection.

Submitted by

S. L. BRABAZON.


A Pole.
B.
C.

LECTURES.

SYNOPSIS

OF A LECTURE ON INSTRUMENTS USED IN SURVEYING, BY W. F. KING, CHIEF ASTRONOMER TO THE DEPARTMENT OF THE INTERIOR OF CANADA.

The lecturer began by saying that as the time at his disposal was short, he would confine his attention to instruments used for measuring angles, particularly horizontal angles. A large number of instruments of different sizes—from the small three inch prismatic transit to a twenty-four inch alt-azimuth—being on exhibition, he used them to illustrate the various points considered.

The essential part of the angle-measuring instrument being the graduated circle, this was first spoken of. Under this head were treated the nonagesimal and centesimal divisions of the right angle, and the sexagesimal and decimal divisions of the degree, also the various modes of numbering the degrees, whether round the whole circle from 0 to 360, the half circle, or the quadrant, and the relative advantages for different purposes of the different modes. The relation between size of circle and fineness of graduation was also treated of.

A short description was also given of the machines used for graduating circles, and the necessity of a number of equidistant verniers, for the purpose of cutting out eccentricity and errors of graduation, was pointed out. Two vernier and three vernier instruments, being those in most common use, were compared, as well as single plate and two-plate or reiteration and repetition instruments. The microscopes used in large instruments, instead of verniers for reading the graduated arc, were described. The manner of supporting the graduated circle was then considered. Under this head comes the question of three or four foot screws, and the kind of instrument on which each is suitable. The graduated circle is held in place in nearly all small instruments, by means of a vertical spindle or axis, which carries all the weight of the upper part of the instrument, no part of the outer rim of the upper plate resting upon the lower plate. Attention was here directed to the twenty-four inch altazimuth, in which the weight of the upper part of the instrument is carried by three small wheels running on the rim of the lower plate, while the central axis is very short, serving only to keep the instrument centred. The tripod was then discussed, and the advantages of the split-leg tripod indicated. Next in importance to the graduated limb came the sights by which the attention is fixed on the object. On the compass plain sights are generally used; but on instruments of more precision, the telescope. The construction of the achromatic object glass and the eye-piece were touched upon, and the arrangement of the threads in the common focus, there being generally parallel threads in astronomical instruments, while for terrestrial work threads meeting in a V are generally preferred. The great importance of the focussing tube of the object glass moving parallel to the line of collimation, and especially moving without wobble, was shown.

A description was given of the manner in which levels are ground in the workshop. The requisites of a good level were stated. Special attention was drawn to the striding level as being invaluable for the best work.

The vertical circle was then spoken of briefly, and some errors of adjustment peculiar to it pointed out, as occurring in instruments where the vernier arm of the vertical circle is attached to one of the standards.

The advisability of having an instrument as symmetrical as possible was shown, especially with reference to unequal expansions of unsymmetrical parts under changing temperatures. A further error in heavy instruments arising from this cause was the flexure of the parts, this being a serious objection to the prismatic transit, which is otherwise a very convenient and compact instrument. This was illustrated by reference to the twenty-four inch altazimuth, in which there is a very large flexure of the horizontal axis due to the telescope being attached to the extremity of this axis, beyond the standards. The lecturer then pointed out that an instrument should be chosen with reference to the work it had to do, and that if a plate of a certain size were chosen the other parts of the instrument should be in proportion, the size of the object glass, the magnifying power, the length and stiffness of the standards, the size and fineness of graduation of the plate, the distance apart of the foot screws, and the strength of the tripod. For instance, it would be foolish to set a finely graduated seven or eight-inch instrument having a powerful telescope upon the ordinary round tripod, and again the split-leg tripod would be unnecessarily cumbrous for use with a small instrument, and a ten second graduation does not suit a half-minute telescope. The lecturer concluded by exhibiting a solar compass, and explaining the manner of using it, and the various errors of adjustment to which it is liable.

SYNOPSIS

OF A LECTURE "SUPPOSED FOSSIL TREES DISCOVERED AT KINGSTON, ONT.," BY H. N. TOPLEY, OF THE DEPARTMENT OF THE INTERIOR OF CANADA.

Mr. Topley first entertained the members of the Association with a series of sciopticon views, consisting of portraits, landscapes and prominent churches and public buildings of Europe. The portraits included the Queen, our Governor-Generals—Lord and Lady Dufferin, Lord and Lady Lansdowne, Marquis of Lorne and Princess Louise, our present Governor, Lord and Lady Stanley of Preston, Sir John A. Macdonald, Sir Hector Langevin, Sir Adolphe Caron, and all the members of the Cabinet. He also exhibited late portraits of the Hon. Edgar Dewdney, Minister of the Interior, and Mr. A. M. Burgess, Deputy Minister, which were greatly admired. The landscape views of Ottawa, Northwest, Yosemite, and along the Canadian Pacific Railway, were generally appreciated. The last mentioned series were from negatives taken by E. Deville, Surveyor-General. Two amusing pictures concluded the above, entitled Topographical Surveyors endeavoring to plot their maps on ice; the second one depicted showed their ludicrous situation, having struck a snag, they went through the ice head first, leaving nothing but their contour lines above. His description of the supposed fossil trees at Kingston was very interesting, being illustrated from photographs. The first picture described was that of a column of red sandstone, fifteen feet high and two feet in diameter. The rock is of pure sandstone, "Potsdam formation," with thin layers of white sandstone intermixed.

The interest taken in these supposed trees is on account of their peculiar formation; the laminations are horizontal, while the column itself is composed of perpendicular circular rings, which has led people to believe that they were fossil trees. The second picture described included a portion of the first, and a large supposed tree, having fallen from its original bed in the rock. This one measured about twenty feet high and five feet in diameter. It had fallen with its outer covering firmly adhering to the shaft, but was broken into three pieces. The third view was that of the sandstone resting on conglomerate. Also drawings of the face of the cliff, showing the erosion which had taken place by the action of an ancient sea after the formation of "the supposed trees." Some maps describing the country in which they were found; one in particular, showing Mr. P. Blake's farm, on which these trees were photographed.

Then followed the four different theories as to their formation. The first theory is that they are fossil trees, but this could not be substantiated according to the science of geology. "The general redness of the sandstone is sufficient evidence that organic remains are very scarce, and so indeed we find it. Two or three fishes, a few leaves, the most perfect is a species of fern, a fir cone, and a few small fragments of thin, hollow bones which may have belonged to either birds or reptiles, are all that have yet been found;" as there is not the slightest indication of either bark, grain, roots or branches, with the naked eye or microscopically, it is quite evident they are not organic or petrified trees.

Second theory.—Pot Holes.—This theory was not sustained from present indications, as none have been found to assume the proper shape, although diagrams and sketches were shown describing their true formation. This theory was also rejected.

Third theory.—"Spring Holes," caused by the pressure of water from the height of land, as the Rideau lakes at present are about one hundred and fifty feet above where these are found.

Fourth theory.—"Spring Holes," caused by indirect volcanic action.—This in connection with the above theory seems to be the true cause of their formation, afterwards becoming filled with the sand, and petrified. In one portion of the rock is to be seen a large supposed tree, about eight feet in diameter, worn away by the action of water, also glacier markings and glacier polished sandstone.

SYNOPSIS

OF A LECTURE ON HOW TO PRESERVE NATURAL HISTORY SPECIMENS, BY PROF. JOHN MACOUN, NATURALIST AND BOTANIST TO THE DEPARTMENT OF THE INTERIOR OF CANADA.

Professor Macoun gave a very interesting description of a method of preserving plants, when in the field, to bring home for future reference. He said that he was on the programme for a lecture, but owing to ill health he was unable to say much, in fact should not have been present at all, but was unwilling to altogether disappoint the meeting. He had brought Mr. Edwards here, who was going to show practically how to skin a bird and preserve a deer's head for future mounting, but before Mr. Edwards began he would like to show a new method of preserving plants.

He then produced two boards, and said they were made of ash, of three thicknesses, the grain of the inside board running the opposite way to that of the outside two. To one board two straps were attached, filled with holes for tightening purposes. The way to preserve plants with these boards was to take thick sheets of paper and place the plants on them, covering again with other sheets of paper, then strapping the boards together, and they could be thrown about anywhere, in the baggage cart, or on the pack saddle.

In reply to a query as to whether it was necessary to get the roots, Professor Macoun said, that with all herbaceous plants you should get the roots, and in all plants you should get the flower, the fruit, and the seed if possible.

In conclusion, Professor Macoun thought it was the duty of every surveyor to bring home a few specimens; he said that it was in that manner that Museums were filled, by each gentleman bringing, say, two birds of a kind, one for himself and the other for the Museum, and it would be not much trouble for them to bring a couple of deer heads; the only thing was that they should know how to preserve them, until they got them home to have them properly mounted, and he hoped that the audience would profit considerably by what they would see from Mr. Edwards, as he was a practical taxidermist, and would be very glad to tell them anything, if they would ask him.

Mr. Edwards then proceeded to give a practical illustration of skinning birds and deer heads, and preparing them for further mounting; he also submitted the following in relation to the same:

HINTS ON SKINNING AND PRESERVING DEER AND OTHER ANIMAL HEADS, FOR THE PURPOSE OF MOUNTING.

MALE DEER.

1st. Make an incision along the centre of the upper part of the neck to about three inches from each antler, then cut across from this incision to the base of each antler, removing the skin carefully from around the horn. When the skin is opened out, a V-shaped cut will be observed.

Separate the ears at the base, being careful to only slit the ear on the *inside* part of the way down, and remove the flesh or grizzle from the base of the ear. Now sever the skin from around the eyes, being very careful not to cut through at the cavities near them. Then pull the skin down over the muzzle, and trim away the flesh from around the lips. It is very desirable that all superfluous flesh should now be scraped from the skin, and when this is done you have it ready for curing. With female deer, or other animal heads having no horns, the cutting need only be made at the base of the neck, and the skin drawn over the head, the same care to be taken in removing it around the eyes, cavities and muzzle.

It must be understood that the longer the hide of the neck is left, or the closer it is cut off to the base, the better and more valuable the head will be.

To cure or preserve the skin, rub the whole on the flesh side with powdered alum and saltpetre; in the absence of these the skin may be rubbed with a liberal quantity of salt, after which roll it up—hair side out—and put away in a dry place for four or five hours when it will be ready to put in place.

In removing the head from the carcass, cut off at the base of the skull, and if any means are at hand to boil the skull, the flesh will be more easily removed than by paring off.

The brains should be removed.

The bones of the under jaws, when cleaned, should be tied together and put in place on the upper jaws. The head is now ready for covering.

Before covering, however, the skin should be sewn up at the mouth and eyes, care being taken to sew from the flesh or inside.

Pull the skin over the head, and before sewing up at the base of the horns or end of the neck, beaver hay, hay or dried grass should be filled in, in such quantity as to allow the skin when dry to resume about its natural shape—especially about the mouth, as in paring off the flesh, the lips invariably stretch, consequently too much packing around the mouth should not be used.

Never cut the skin down the front of the neck, the seam when sewed is sure to show and be distasteful to the eye.

EXPLANATION OF A ROLLING PLANIMETER.

Mr. ABREY said the best thing he could do would be to read an extract from a description of the instrument written by himself, published in the Report of the Association of Ontario Land Surveyors, for 1888.

Mechanical Integrators are constructed on the assumption that if a wheel is moved over a smooth surface, in the direction of its axis, it will slide without revolving, and if moved at right angles, it will revolve without sliding, and if moved in any other direction it will both slide and revolve.

The instrument here exhibited is mounted on rollers of equal size and equally weighted, and when moved over a figure the fulcrum of the tracing arm moves in a straight line, and differs from the Polar instrument in general use. It possesses great advantages over Polar Planimeters, inasmuch that it will measure at one operation a figure of considerable width and of unlimited length. It is also more easily manipulated than a Polar.

In moving the instrument around a figure, the arm is always in a line nearly at right angles with the axis of the rollers, and very little difference in force is required to move the tracer over one part than another, whereas with a Polar, it is required over some parts to move nearly in line with the anchor point, and then, from the greater force required, the tracer goes by a more or less jerky motion.

The instrument is also what is called suspended, and possesses greater precision than any yet constructed, and although a large instrument it is very precise in measuring small figures. Of course, like all planimeters, it requires great care, and every part must go smoothly and without shake in any part.

In describing the theory of this Rolling Planimeter, it is convenient to develop it by a system of rectangular coordinates. The tracing arm is at right angles to the plane of the recording wheel, and the axis of the recording wheel is parallel to the tracing arm. In moving the instrument it will be observed that the speed of the recording wheel increases as the tracing arm moves away from the line, drawn through its fulcrum, at right angles to the axis of the rollers, and reverses its motion in passing the said line, therefore with tracer on the said line, the recording wheel generates no motion; it will also be seen that if the rollers remain still, the moving the tracer to either side does not cause the recording wheel to revolve, as it simply slides on the disc in the direction of its own axis.

For the mathematical proof of the theory oft he instrument, see the above Report for 1888.

Its theory is explained a little differently in Professor Johnston's Surveying, and if I have understood what is there stated, his explanation is not exact. He uses the expression end ordinates, whereas it should be equal end ordinates; for, to simply pass the tracer over the irregular path of the boundary would give the area of a figure with curved outlines, and not that bounded by the Y ordinates.

From the theory, it will be seen that the distance of the recording wheel from the tracing arm is immaterial, and is not a function of the area, but the axis of the recording wheel must be parallel to the axis of the tracing arm, else the area generated by the tracer on one side of the axis will be greater than on the other. The instrument is fitted fully for testing and correcting its errors.

The instrument measures the area of the plotted figure drawn to scale; this record then requires a suitable multiplier to get the area of the field or section of which the plot is the diagram. In practice it is desirable that the point from which we start to trace be taken, so that the tracing arm shall be at right angles, or nearly so, to the axis of the rollers, as a small error in bringing the tracer back in closing is then a minimum; also, if possible, an approximately equal area should lie on each side of the tracing arm when so placed at starting, to eliminate any remaining error in the axis of the recording wheel.

The figure should be traced slowly and by an easy motion forward, too great a speed or a jerky motion may cause the recording wheel to slip.

The accuracy and precision of this instrument may be seen from the published tests.

In repeating the tracing of a figure the difference should not be more than about 0.002 of each other.

With an Amsler Polar, I found the difference of two readings might be about .02 on the vernier, and was not satisfied with anything greater than that.

This error would be about the same independently of the size of the figure. With this instrument the error is nearly some per cent. of the size of the figure.

In the instrument there is a counting wheel, having a differential motion counting revolutions of the recording wheel up to 420.

The vernier of the recording wheel sub-divides its circumference into 1,000 equal parts. The tracing arm is divided into half millimeters. For English measures the makers have given the value of a single division of the vernier for .0025 sq. in., .002 sq. in., .0015 sq. in., .00001 sq. ft., .001 sq. in., .0005 sq. in., as corresponding to divisions on the tracing arm of 830.4, 671.7, 513.3, 493.8, 354.6, and 195.3 half millimeters. With care in tracing the instrument should give a true area of the figure to within the 1:1000 to the 1:10000, depending on its size.

DESCRIPTION OF AN IMPROVED STEEL BAND CHAIN.

Mr. Brownlee said that with the permission of the President he would give a short description of an improvement in a steel band measure, invented by A. J. Brabazon, D.L.S., of Portage du Fort, Que. The improvement consists in double-jointed, flat swivles, at 20 feet, 25 links, apart on the coil, as the case may be.

The claims for the swivle are as follows:—

1. Reduction of liabiltiy to breakage from kinking.
2. Facility in measuring up or down hill, when shorter measures than full length of chain are required.
3. The reduction of wind pressure on chain, as at least one half the length of chain will adjust itself edgewise to direction of wind.

Mr. Brownlee also exhibited a simple clip and field tools for applying same over the severed or broken edges of a steel band.

This invention does away with the use of rivets, and is a simple and effective method of repairing a chain in the field, the box of tools required is about the size of 4 x 2 x 1 inches, weighing about 1 pound, and is just the thing for chainmen to carry along with field books.

PAPERS.

OCCULTATIONS OF STARS BY THE MOON.

It is frequently desirable, in explorations, to be able to determine the longitude of a place within a reasonable degree of accuracy. The independent methods of doing this, *i.e.*, methods requiring only astronomical observations, are few. The method of occultations is one of the most accurate of these. The observation requires no instrument, except a good telescope. Of course, for longitude, the correct time must be known, which will necessitate an instrument for that purpose, but the observation of the obscuration of the star by the moon, or its reappearance, may be made with any telescope.

In the lists of occulted stars published in the Nautical Almanacs, stars down to the sixth magnitude are given. Occultations of these small stars by the dark limb of the moon are readily observed, but they cannot be observed on the bright limb, except with a very good telescope. However, stars of the third magnitude or higher, and especially the larger planets, can be observed with small telescopes.

The time at which the moon's centre and the star, as viewed from the centre of the earth, have the same right ascension, is given in the almanac. This is not the time of immersion or emersion, since the semi-diameter of the moon must be allowed for, as well as its parallax, which last has a very great effect, and varies according to the altitude of the moon.

On this account, the actual time of the immersion or emersion may differ from the tabulated time of geocentric conjunction by an hour or more. Hence for the purpose of preparing for the observation, a calculation of the approximate time of the occurrence is necessary.

This calculation, if made in figures, according to the methods given in the text books, is tedious and intricate.

My object in writing this paper is to give a method by graphical construction, by which calculation in figures is almost altogether avoided, as well as the intricacy of the process, and the liability to error is consequently obviated. The method consists in drawing the projection on the plane through the centre of the earth at right angles to the direction of the star, of the path of the observer in space as he is carried along by the diurnal rotation of the earth, and of the path of the moon. If a time can be found at which the observer and the moon's centre are separated by a distance equal to the radius of the moon, the immersion or the emersion will take place at that instant. The example below will serve to make the process clearer.

The latitude of the place must be known, and also the approximate longitude. From the latitude must be first found the geocentric coordinates of the place by adding to, and subtracting from, the logarithmic cosine and sine of the latitude, the logarithms of F and G respectively, given in the following table :

Lat.	Log. F.	Log. G.
40	0.00062	0.00239
45	0.00075	0.00226
50	0.00088	0.00213
55	0.00101	0.00201
60	0.00113	0.00189
65	0.00124	0.00178
70	0.00133	0.00169

The two results thus obtained must be multiplied, the first by the sine of the star's declination, and the second by the cosine.

As an example of the method of working, I will suppose that an observer, at Ottawa, on the 25th Jan., 1888, wishes to observe occultations for longitude.

Looking at the list of occultations in the American Ephemeris at 25th Jan., 1888, we find that nine occultations occur that day, visible somewhere on the earth's surface, but we see that the first two on the list occur during day-light. The third occurs after sunset, its hour angle is only about 2½ hours from the meridian, and the limiting parallels of latitude are + 58° and 0°, between which limits falls the latitude of the place 45° 23′, so that we may infer that this occultation may be visible. It should be stated here that it does not necessarily follow that because the limiting parallels include the latitude of the place that therefore the occultation will be visible. The visibility depends also on other conditions which will appear in the working. When some practice in this method is acquired, the computer can frequently decide as to the occurrence of an occultation by the tabulated value of Y, together with the hour angle. The fourth star, χ_4 Orionis, is right as regards time of occurrence and hour angle, but not as to limiting parallels. The next two stars also fulfil these three conditions, but the remaining three are ruled out by the limiting parallels, Thus for this night, we have to compute χ_2 Orionis, 68 Orionis, 71 Orionis.

For an example of the prediction we take 68 Orionis.

We have now for the place of observation (Ottawa), latitude = 45° 23′, longitude 75° 42′ west of Greenwich, or 5.4m. east of Washington.

For the star we have from the Almanac.

δ = Declination = + 19° 48′.8

Washington mean time of conjunction = 10h 45m.7

Then we have:—

	$\log\cos\phi = 9.84659$	$\log\sin\phi = 9.85235$
From table given above	$\log F = 0.00076$	$\log G = 0.00225$
	$\log\rho\cos\phi' = 9.84735$	$\log\rho\sin\phi' = 9.85010$
$\delta = +19° 48'.8$	$\log\sin\delta = 9.53014$	$\log\cos\delta = 9.97350$
	9.37749	9.82360

whence

$\rho\cos\phi' = 0.7036$

$\rho\cos\phi'\sin\delta = 0.2385$

$\rho\sin\phi'\cos\delta = 0.6662$

	H. M.
From Ephemeris:—Washington Hour Angle at Geocentric Conjunction	+ 0 59.9
Difference of Longitude, Washington to Ottawa	— 0 5.4
Ottawa Hour Angle at Geocentric Conjunction	+ 1 05.3
	= 16°.325

In the figure *AB* and *AH* are drawn at right angles to one another, each equal to $\rho\cos\phi' = 0.7036$. $AP = 0.2385$, $AC = 0.6662$.

Any convenient unit may be used for these lines. For instance, 10 inches will be found a sufficiently large unit to give good results, at least when the star's hour angle at occultation is not more than three or four hours. With this unit *AB* or *AH* would be 7.04 inches, *AP* 2.38, and *AC* 6.66, and all lengths of lines throughout the calculation must be multiplied by ten to give the lengths in inches to be measured on the diagram.

C is then the centre of the earth, and *B* and *P* the extremities of the major and minor axes of the elliptic path of the observer.

The star being above the equator, the part of the ellipse below the line AB is taken.

The angle HAH_0 is made equal to 16°.3 to the *east* of AH, since the hour angle is positive and the place is therefore east of the star.

The angles H_0AH_1, H_0AH', $H'AH''$, are each made equal to 15° or one hour.

More correctly these angles should be 15°.04, or the sidereal equivalent of one mean solar hour, since the mean solar hour is the unit of the quantities x', y', below, but 15° is sufficiently close, since the angles are laid off with a protractor.

From H_1, H_0, H', H'' perpendiculars are drawn to AB, meeting it in A_1, A_0, A', A''.

The proportional compasses are now set to the ratio $AH : AP$, and the perpendiculars from H_1, &c., are divided in the points P_1, P_0, P', P'', by means of the compasses, in this ratio.

These latter points are points on the ellipse. P_0 represents the observer's position at the time of geocentric conjunction, P_1 at one hour before, P' at one hour after, and P'' at two hours after.

From the Ephemeris are found $Y = + 0.3659$, $x' = 0.5686$, $y' = + 0.0358$.

CM_0 is taken equal to .3659, M_0 being above C, because Y is positive.

M_0D is drawn equal to $y' = + 0.0358$, still upwards because positive.

DM' is drawn at right angles equal to $x' = .5686$, always to the right, being always positive.

M_0 is then the position of the moon's centre at conjunction, M' its position one hour after. On M_0M' produced take M_0M_1 and $M'M''$ each equal to M_0M'. Then M_1 is the moon's position one hour before conjunction, and M'' two hours after conjunction.

Hence the points M_1, M_0, M', M'' correspond to P_1, P_0, P', P' respectively.

Now at the instant of the star's disappearance under the moon's limb, or reappearance therefrom, the distance between the projections of the observer's position P_1 and the moon's centre M_1 must be exactly equal to the moon's radius, which is .2723 (or 2.723 inches with the supposed unit of 10 inches).

By measurement we find :—

$P_1M_1 = .5944$ $\qquad$ $P_0M_0 = .2130$
$P'M' = .2096$ $\qquad$ $P''M'' = .6264$

Hence the two points at which $PM = .2723$ lie one between P_1

and P_0, and the other between P and P', and the time of immersion is found by:—

$$\tau = \frac{2723 - 2130}{5944 - 2130} \text{ of an hour} = 9.6 \text{ minutes.}$$

and of emersion by

$$\tau = \frac{2723 - 2096}{6264 - 2096} \text{ of an hour} = 9.0 \text{ minutes.}$$

Hence we have for a first approximation:—

Immersion at 9.6m before the moon arrives at M_0, *i.e.*, at 9.6 minutes before conjunction.

And the emersion takes place 9 minutes after the moon arrives at P', *i.e.*, at $1^h\ 09^m.0$ after conjunction.

For a closer approximation we may now plot in two points, one 10 minutes before conjunction, and the other 1h. 10m. after conjunction, making the angles H_0Ah, $H'Ah'$ each equal to 2½°, and proceeding as before, p and p' being the corresponding points on the ellipse, m and m' are the corresponding points on the moon's path, $m\ M_0$ and $m'M'$ being each one-sixth of M_0M'.

Then we have by measurement:

$$M_0P_0 = .2130 \qquad mp = .2750$$

whence we get

$\tau_1 = 9.6$ minutes agreeing with the former result. $M'P' = .2096$ $m'p' = .2776$ whence $\tau_2 = 9.2$ minutes.

Hence the immersion and emersion respectively take place 9.6 minutes before and 1h. 09.2m. after conjunction.

From the ephemeris we have

		H.	M.					
Washington M. T. of conjunction		10	45.7					
And difference of longitude	=	—0	5.4					
Ottawa M. T. of conjunction	=	10	51.1		H.	M.		H. M.
Therefore Ottawa M.T. of immersion	=	10	51.1	—		09.6	=	10 41.5
And Ottawa M.T. of emersion	=	10	51.1	+	1	09.2	=	12 00.3

The angle of position of the star at immersion measured from the north point of the moon's limb towards the east is the angle between the direction $\mu\ \pi$ and HA or, 74°, μ and π being the final positions of the moon and the observer at the calculated instant of immersion.

Similarly for emersion the angle is that between the directions $\mu'\ \pi'$ and HA or 283°.

The angles of position from the vertex of the moon's limb are the angles between $\mu \pi$ and $C\pi$ and between $\mu' \pi'$ and $C\mu'$ or 52½° and 243° respectively.

The determination of the angle of position enables the observer to know at what point of the moon's limb he is to watch for the star. The angle from the north point is required when the instrument is mounted equatorially, and that from the vertex or highest point of the moon's limb, when an ordinary altitude and azimuth mounting is used.

The time of immersion or emersion is obtained by this method easily within a minute, which is quite close enough for the purpose of preparing for the observation. The exact time of immersion is, of course, of less importance than that of emersion.

The second approximation as given above is unnecessary in the present case, and is in general not required when the time of occurrence comes within 15 minutes of one of the points plotted. But when the star passes far from the centre of the moon, this limit of 15 minutes must be reduced. In fact, when the moon merely grazes the star, careful measurement is necessary to tell whether the occultation will occur at all or not. However, in such cases, the observation is not of much use for longitude.

It is easily perceived at or near the beginning of the work, when the moon's centre passes at a greater distance from the projected place of observation than the moon's radius, so that the occultation cannot occur, and much trouble will thereby be saved.

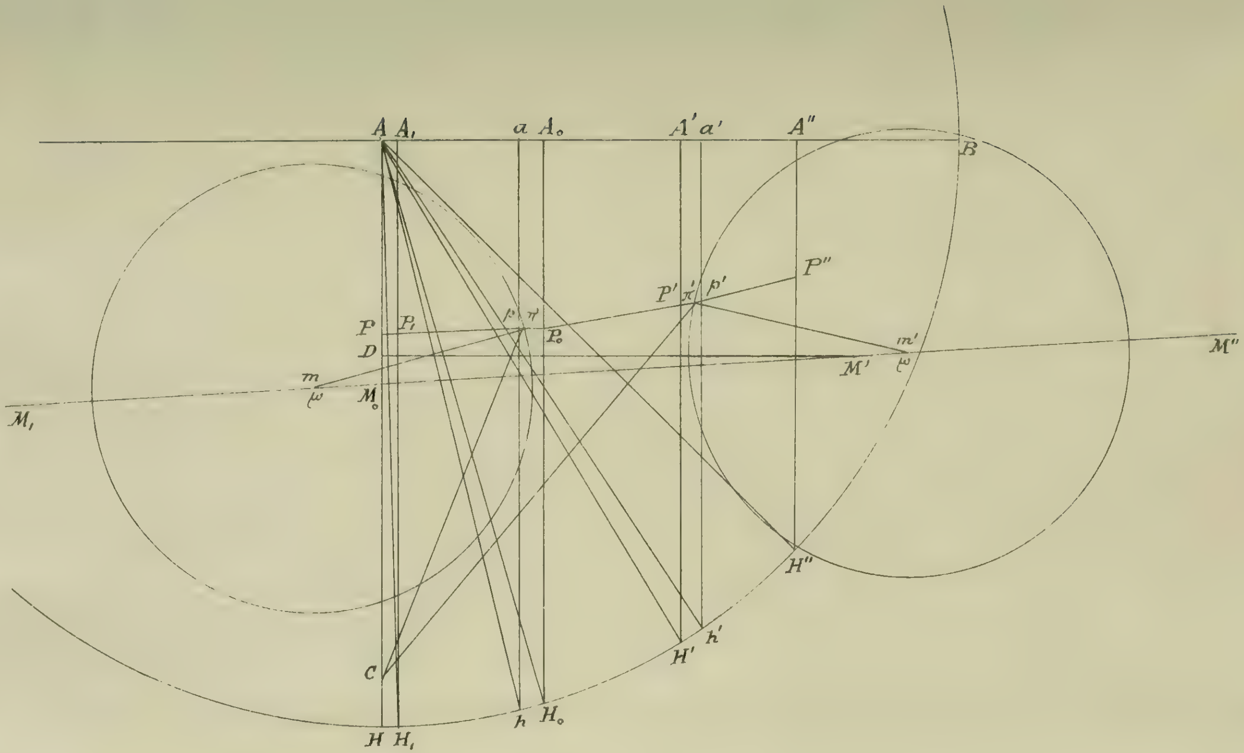
With a little practice, it requires but a few minutes to predict an occultation by this method.

W. F. KING.

DISCUSSION.

O. J. Klotz.—I have tested the methods as set forth in Mr. King's paper, and found that in from 15 to 20 minutes it can be ascertained whether there will be an occultation or not; by the old logarithmical method it would take from 3 to 4 hours.

A Member.—If you are in good working order, you can ascertain this by the old logarithmical method easily in two hours.


A
A₁
a
A₀
A′
a′
A″
B
P″
P′
π′
p′
P
P₁
p
π
P₀
D
m
μ
M₀
M₁
M′
m′
μ
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C
H
H₁
h
H₀
H′
h′
H″

PRACTICAL PROSPECTING FOR GOLD AND SILVER, AND THE PRELIMINARY DEVELOPMENT OF METALLIFEROUS VEINS.

Surveyors in the practice of their profession have many opportunities of examining the rock formation, and ascertaining to some extent the mineral resources of various parts of the country, and, although many members of the Profession and of this Association are quite as well posted as I am on the above subjects, others may not have given them much attention, and will not object to a few hints that may assist them in determining when they are in a country that may be expected to produce gold, silver, or other ores; how to search for the same in an intelligent manner; and how veins may be opened up in a preliminary way, so as to ascertain, as cheaply and quickly as possible, the character, value per ton, and probable production of ore, thus determining the nature of reduction works required, and being enabled to estimate the cost of mining and reduction plant necessary to work the mine to its full capacity, and of the returns and profits that may be anticipated.

It is said that most of the great mines of the world were found by chance, and not by regular prospectors. This is probably true as regards lodes and veins; but it must be remembered that until within very recent years the average miner or prospector had little or no knowledge of the rock formations in which gold, silver and other metalliferous veins were likely to be found, and simply roamed over the mountains in a haphazard way, and was as likely to look for gold quartz in cretaceous limestone as in metamorphic slates, or to follow the wrong formation longitudinally as to cross it and get into a better one.

One instance, however, may be mentioned, where intelligent observation and persevering search led to the discovery of immense gold fields and the settling up of a great continent, namely, the discovery of gold in Australia by Hargraves in 1851.

Nothing will build up a new country so rapidly as the discovery of gold and silver mines. Agricultural and manufacturing enterprises are of slow growth, no matter how fertile the soil or how excellent the facilities for successful operation, unless they are given an impetus by something such as the discovery of gold or silver, which will cause an immediate influx of population.

When such a rush occurs, as is generally the case on the first opening up of a new mining country, the work of exploring and development goes on rapidly, and all the resources of the country are developed in a proportionally rapid manner. Lumbering, farming, and stock raising enterprises spring at once into existence, as the mines furnish a ready market and good prices for their products.

The old pioneer prospector is rapidly disappearing, and organized prospecting and exploring parties, under the direction of competent mining engineers and experts, are taking his place ; and this manner of acquiring mineral properties will be largely adopted in the future, as being the cheapest and in every way the most satisfactory manner of gaining possession of valuable mining rights.

The head of such a party, starting out to prospect any particular range of country, would first acquaint himself with all the geological and other information to be had from the reports of the Geological Survey, and other parties who had visited the region of his intended explorations. Failing such sources of information he would take such reports and evidence, as he could find, relating to the mineral resources, etc., of other districts on the same geological belt or mineral zone, and thus get some idea of where to look for the particular class of ore or mineral desired.

The following extracts from an article, on "Mineral Zones and Mountains" from the "Mining and Scientific Press," will help to explain this point.

"One of the plates accompanying King's Exploration of the 40th "Parallel is a section of the Warren Map of the U. S. Engineer "Department. The section given includes the main central region "of the Great Basin, with a part of the coast system of California, "and the outlying chains of the Rocky Mountains. A brief study "of this map will teach the *one great and prominent law of* "*arrangement of Cordillara Mountain chains*, namely, *that they* "*trend from North to South, or from Northwest to Southeast.*

"In strict subordination to this longitudinal direction of ranges, "says King, are grouped all the structural features of local geology. "The average strike of the great areas of upturned strata is "generally with the meridian. All the larger outbursts of granitic "rocks conform to it as well, since their rents are most commonly "the axial lines of actual folds ; and lastly, when the tertiary uplift "occurred, its ranges bordered the older mountains in parallelism, "and the volumes of lava accompanying it found exit through "longitudinal rents, and either built themselves up along the "ancient line of structure, or through new fissures piled up chains "of volcanoes conforming in trend with the general north and "south plan.

"*Over these mountains are found localities* of the *precious* "*metals*, and it is not surprising to observe that, following its "leading structural idea, *they appear to arrange themselves in* "*parallel longitudinal zones.*

1. "The Pacific coast ranges on the West carry quicksilver, tin, "and chromic iron.

2. "The next belt is that of the Sierra Nevada and Oregon "Cascades, which upon their west slope bear two zones; a foot-hill "chain of copper mines, and a middle line of gold deposits. These "gold veins and the resultant placer mines extend far into British "Columbia and Alaska.

3. "Lying to the east of this zone, along the east base of the "Sierras, and stretching southward into Mexico, is a chain of "silver mines containing comparatively little base metal, and fre-"quently included in Volcanic rocks.

4. "Through Middle Mexico, Arizona, Middle Nevada and "Central Idaho, is another line of silver mines, mineralized with "complicated association of the base metals, and more occurring "in older rocks.

5. "Through New Mexico, Utah, and Western Montana lies "another zone of argentiferous galena lodes.

6. "To the east again the New Mexico, Wyoming and Montana "gold belt is an extremely well defined and continuous chain of "deposits."

From this it can be seen how any information relating to the geological structure, and rock formations of a district, or the character of its ores, will assist in determining what may be expected at other points, in similar respective positions, on the same range. As an illustration of this, I may mention the fact that on the Selkirk Range, in Kootenay District, B.C., large and valuable lodes of silver-bearing lead and copper, associated with other base metals, have lately been discovered. The ores of this district correspond in character with those of Idaho and Western Montana, immediately south and on the same range, and with those of mineral zones 4 and 5.

It being a fact that nearly all the valuable gold-bearing veins of the world have been found in metamorphic slates and schists of different ages, from the Silurian in Australia to the Jurassic in California; it is more resonable, and one is more likely to prove successful, in searching for gold, to confine one's explorations to metamorphic rocks. In like manner, all the great gold placers, being chiefly composed of sand, clay, gravel and boulders derived from these and allied rocks, it seems reasonable to prospect for gold placers on the lower slopes and benches of mountains and hills composed of such rocks (particularly where traversed by many quartz veins), and on the rivers and streams draining a country of the above character.

Gold-bearing lodes may be looked for in quartz veins traversing, nd interstratified with the softer metamorphic crystalline rocks such as argillaceous, chloritic, talcose and hydromica slates and schists ; also, to a much less extent in granite, gneiss and the harder metamorphic rocks.

The minerals or ores commonly associated with gold, in quartz veins, are iron, copper, lead and zinc sulphurets, and sometimes tellurium ; the presence of one or more of these being considered a good indication in a gold country, and their entire absence as unfavorable to the permanency and regular yield of the lode—even though free gold may be visible in the quartz. The most permanently productive gold quartz mines have been those in which free gold was seldom or never seen, and the above sulphurets were more or less represented.

The quartz is frequently rusty or cellular, and discolored brown, yellow, reddish, blue, etc., by the decomposition of the base ores accompanying the gold.

The most certain and reliable way of finding out if a quartz vein carries gold, in paying quantities, is to pound up pieces from different parts of the vein and pan them out. If the quartz is pounded very fine, and then carefully washed down in a pan or horn, fine particles of gold will be found, and can be seen with the naked eye, if there is sufficient in the quartz to pay for working ; and it is not worth while spending much time over a vein (as a gold vein), unless colors can be found in that way. Of course gold is found in paying quantities associated with ores of silver and other metals, as in the Comstock Lode, where its presence cannot be ascertained by simply panning out ; but this really comes under the head of silver ore, and will have to be assayed in a similar manner.

Veins and streaks of solid arsenical and other pyrites often carry gold, in what would appear to be paying quantities ; but such mines have seldom been worked successfully.

Silver and its ores are so intimately connected with many of the ores of lead, copper, antimony, zinc, etc., that in indicating the rocks in which we may expect to find silver-bearing veins, we necessarily include the others.

Native silver, Ruby silver, and silver ores proper, and such as are mixed with base metal ores to only a limited extent, are found most frequently in Syenite, Trachyte, Andesite, Porphyry,—Gneiss and allied metamorphic rocks,—and in shaly sandstone, conglomerates, etc., in the vicinity of eruptive rocks, and generally in a quartz gangue. Argentiferous galena, and carbonate of lead carrying silver, argentiferous grey copper ore, etc., in argillaceous shale and schists, crystalline limestone, etc., and porphyry. And low grade argentiferous galena and carbonates in carboniferous and other limestones.

The vein matter, or gangue, may be quartz or calc-spar, or both, and may be mixed with heavy-spar, flour-spar or pearl-spar; and in some of the largest and most productive lodes the vein matter is chiefly yellow and brownish clay, with boulders of iron maganese rock, and horses of the country rock, and in this character of gangue the largest chimneys of galena and carbonates, carrying silver, have been found.

The character and value of silver ores cannot be accurately determined, except by regular assay. They are mixed with so many other ores and minerals, that in many cases they cannot be distinguished from the ordinary ores of the base metals. After long experience a man may be able to form a fair estimate of the ores of the particular district in which he has been working; but take him into a new district where the combinations are different, and his opinion as to the value of an ore, from simple inspection, is quite worthless.

A collection of small specimens of different metallic ores, which can be obtained in New York, and readily carried along, will be of some assistance; and with a blow-pipe outfit, tests which will determine at least the presence or absence of silver, and many of the other metals, can be made. These with "Danas' Manual of Mineralogy," an elementary treatise on geology, and a book of instructions for the use of the blow-pipe—a gold pan or horn, and a bottle of Nitric Acid—will enable one to get a fair idea of any ore, rock, or mineral we may come across.

A pick and shovel, hand-crushing machine, or pestel and mortar, and one or two rock hammers and small prospecting poll picks should be carried along; and on regular prospecting expeditions, where such things can be packed or carried, a small bellows and anvil, drills, striking hammers, powder, fuse, caps, etc., should form part of the outfit.

In prospecting a given belt of country, it is best to cross it as often as possible, and where the rock formation is most exposed; following up the beds of the streams, where practicable, and making lateral excursions at convenient points, and where the formation seems favorable.

At, or near, a change of formation, say from slate to granite or limestone; and near porphyritic or other igneous rocks, in stratified and metamorphic beds, large and productive lodes may be looked for.

Large veins are generally split up, or divided into several branches, in the valleys and crossings of streams; but the large and solid outcrops can generally be found on the high ridges on either side, by taking the general direction of the veins at the crossing, and it is usually on these ridges or hills that the largest and most valuable deposits of ore are found.

Preliminary Development:

The first thing to be done in opening up a lode is to ascertain the extent of the ore-body on the surface, so as to determine the best place for a shaft or tunnel. This can be done by sinking to bed rock at several places along the general line of the lode, where it is not already exposed, and making cross-cuts at these points. If the mine is to be opened up by means of a shaft, it may be located about the centre of this ore-body, and should follow the vein down. The dip of a vein is so liable to change near the surface, that a perpendicular working-shaft cannot be properly located until prospecting works have been carried to a depth of at least 200 or 300 feet. Drifts or levels should be run about every 60 feet, and, where the vein is wider than the drift, cross-cuts should be made at about the same distances apart. The extent to which this work should be carried, and the size of shaft, etc., must be determined by the nature of the vein and its ore, the developments made in sinking and drifting, and the amount of money the manager has at his command for this purpose. A shaft from 200 to 300 feet deep, and drifts as above, say 120 feet on each side of the shaft, with cross-cuts about every 60 feet, will generally be considered sufficient to decide the probable value of the property, and the cost of mining and reduction works for permanent operation.

The ore taken out of the shafts and drifts will help to pay for the work, and the mine will be in a condition to put on men enough to stope out ore while reduction works are building, to keep them running while the permanent working shaft is being put down.

If the vein crops out on a side hill, or bluff, so that a tunnel can be run *along the vein*, at a sufficient depth from the outcrop on top, much time and money can be saved, and both hoisting and pumping works dispensed with. But if the strike of the vein is such that the tunnel must be run any distance *through country rock*, before encountering the vein, it must be prospected and proved to a sufficient depth, before a tunnel can be attempted without great risk of miscalculation and disappointment.

In lodes that are not too wet, rock and water can be hoisted for the first 100 feet by windlap, and from 200 to 300 feet by a whim; but where much water is encountered an engine will be required.

The following points in relation to Mining Claims should be carefully noted:—

1. Location or position on the Map.
2. How to reach it, and condition of roads, trails, &c.
3. Course, or strike, width and dip of vein or lode.
4. Class of ore or mineral, as nearly as can be ascertained.
5. Quality " " " and samples, if possible.
6. Length and width of ore-body exposed.
7. Gangue or matrix of vein.
8. Character of walls.
9. Country rock.
10. Water-power, if any, fall, No. of inches, &c.
11. Quality and cost of wood, timber and lumber.
12. Cost of labor and board.
13. Price of provisions, grain, hay, &c.
14. Rate of freight from nearest railway station, steamboat landing, or town.
15. Distances from do.
16. How lode is situated for development by tunnel or shaft.
17. Distance and freight to nearest smelter or reduction works; rates paid for ore, or charge for reduction.
18. Remarks on climate, labor, supplies, grass, &c.
19. Sketch of claim and surroundings.

In closing this paper I will quote the following from a Report to the Legislative Council of Victoria, Australia, M[illegible], 1854:—

" The discovery of the Victoria gold fields has converted a remote

" dependency into a country of world-wide fame; it has attracted a " population, extraordinary in number, with unprecedented rapidity; " it has enhanced the value of property to an enormous extent; " it has made this one of the richest countries in the world; and in " less than three years it has done for this colony the work of an " age, and made its impulses felt in the most distant parts of the " world."

Knowing the immense results that have followed the opening up of mines in Australia, California, Nevada, Montana, &c., one would suppose that our government (both Provincial and Dominion) would offer every inducement to prospectors and miners to prosecute their work of exploration and development, instead of hampering them with unnecessary and harassing rules and regulations. The mining laws of all the Provinces and the Dominion should be assimilated, and many alterations made; and mining machinery, which cannot be or is not manufactured in Canada, should be admitted free of duty, at least until such time as we can manufacture it ourselves.

JAMES BRADY.

VICTORIA, B.C., Feb. 11th, 1889.

REFLECTION OF THE ELECTRIC LIGHT.

The following short series of observations was taken with a view of determining approximately at least the range of elevation at which reflections from the electric light are visible. The reflections observed and considered are only those of the atmosphere and not those of clouds.

The place of observation was Preston, the electric lights being in Galt. The distance of the point of observation from the centre of the lighted area is in round numbers two hundred and fifty chains, and the direction south-east. There are 32 lights of 2000 candle power each; there are two dynamos of the Thomson spherical machine design; one dynamo is used for street lighting, the other for private lights. An 80 H. P. engine supplies the power. The area in which the lights are distributed is 110 chains north and south, by 65 chains east and west. There are twelve miles of circuit.

It is self-evident that in observations of this kind, where there is no sharp line of demarcation between artificial light and stellar light, the telescope is inapplicable.

At first a graduated rod with a draughtsman's square was used for obtaining the angular elevation, the line of sight passing over the square (which was slid up and down the rod), and the ridge of a building nearly at right angles to the line of sight. It was soon found however that this method gave too small a range of elevation, so it was changed to that of using a variable base. On a level piece of ground were marked off various distances, then having measured with the instrument at the height of the eye at the distant point, the angle of elevation of the ridge above referred to, the elevation at the other points immediately follows, and sufficiently accurate by a graphical solution.

The light of these 32 electric lamps was however not distributed equally in all directions. Twelve of the lights have two sets of carbons, but not burning at the same time; these lights are covered by a hood ten and a half inches in diameter. When the current first passes, the carbon points are on a level with the hood, so that no direct upward illumination is possible; during the process of combustion, the lower point or negative pole is lowered, while the upper one follows it by automatic arrangement. This lowering continues for six inches when the current is made to pass over the adjoining fresh set of carbons. We see therefore that on account of the hood the minimum direct upward illumination is nil, and the maximum of these 12 lights is only three-eighths of the whole.

The remaining 20 lights carry only one set of carbons, and are without a hood; the points at lighting being 14 inches beneath a rectangular box 5 by 6½ inches, carrying the adjusting magnetic mechanism, the points being lowered during combustion six inches as in the previous case. These latter lights give a direct upward illumination of nearly one-half of the whole.

Now of the direct upward illumination for observation by reflection, it is seen that the 12 lights furnish very little light, as at the maximum the rays are sent out at an angle of 45 degrees to the horizon; the inclination of the rays of the 20 lights at their maximum being about 81 degrees to the horizon.

Light either emanates from a luminous body or is reflected from illuminated bodies. In our observations we have to deal exclusively with reflected light. The intensity of light varies as the square of the distance, whereas the brightness remains practically the same within wide variations of distance.

The air is composed of gases and aqueous vapor, both reflect light; but in consequence of the lowness of the refractive index of the former, both the reflection and refraction thereof are feeble.

The gases of the atmosphere we may assume as constant, but not the aqueous vapor or hygrometric condition of the atmosphere, and as it is mostly from this vapor under various conditions that we receive the reflections, it will be seen that our observations must to a very great extent follow the fluctuations of the percentage of aqueous vapor in the upper regions of the atmosphere. Another factor from which reflections may be received is the microscopic dust floating in the higher regions; but as the observations were taken in the winter when the ground was covered with snow, it is assumed that the effects of this factor are inappreciable.

A cloudless sky is the best condition under which to take observations for the purposes of this paper, for only then are we certain that the maximum height observed is situate directly over the lights. Knowing the length of the base line of our right angle triangle, the linear height of the visible reflected light is readily found. It sometimes happens that a cloud is floating somewhere above the illumined upper area, and from its more compact form of accumulated aqueous vapor possesses higher reflective powers, and will hence show more reflected light than is otherwise visible. But as one observer cannot by angular measure fix the position of a cloud, it is impossible to deduce the linear height of reflections as seen emanating from a cloud. I have on several occasions seen on clear nights with a single cloud hanging over the illumined area reflections from the cloud, when many degrees beneath it no reflections from the atmosphere were visible.

Now besides the direct rays that illumine the upper regions, rays from the lower strata of the atmosphere are also reflected upwards, and in a large measure go to illumine the upper strata upon which observations are made.

On a clear night with little moisture in the atmosphere, it will be noticed that the illumination by the electric light on surrounding objects, such as buildings, is especially bright, shadows sharply defined, and places such as lanes or side streets where the direct rays do not fall especially dark. But if it rains, a marked difference will be noticeable, the above bright illumination of buildings will be more subdued, and on the other hand lanes and side streets where no direct rays fall comparatively bright. This results from the reflection from the innumerable drops of rain. The same phenomenon is produced by falling snow.

But when it is snowing it is more difficult, in fact often impossible, to make satisfactory observations of elevation than when raining, because the snow does not transmit rays of light as drops of water do, as each snow-flake is composed of many crystals, and the light is lost by repeated reflections.

It may be stated that by reason of reflection of light, a cloud projected against the sun appears dark or black, because few rays are transmitted through the cloud, that is there is an absence of light in that part of the sky, and hence appears dark; a cloud so situate, however, that the reflections can reach the eye will for similar reasons appear white.

Date.	Elevation	Elevation in feet.	Relative humidity	Thermometer.	REMARKS.
1889.					
Jan. 19	10°	2900	83		Clear sky.
" 20			99		Snowing, no light visible.
" 21	18°	5400	83	22°	Some light, fleecy clouds.
" 22	7°30′	2200	82	23°	Starlight. No clouds. Light diffused.
" 23	2°40′	800	89	35°	Sky overcast. No stars visible. Light spread more laterally than vertically.
" 24	2°35′	700	85	28°	Starlight, no clouds. Light faint.
" 25	2°35′	700	75	31°	" " " " "
" 26			93	26°	Starlight overhead, but heavy haze on horizon. No light visible.
" 27			91		Snowing. No light visible.
" 28			78		Absent from home.
" 29			78	11°	Starlight; a very light haze on horizon and no light visible.
" 30	45°	16500	89	22°	Light snow; sky overcast, yet here and there stars dimly seen. Light not bright but widely diffused.

Date.	Elevation	Elevation in feet.	Relative humidity	Thermometer.	REMARKS.
1889. Jan. 31	21°	3500	73		Starlight, but hazy on horizon. Light diffused, but a light cloud showed the reflection higher than could otherwise have been judged.
Feb. 1	35°	11600	83	14°	Starlight; hazy; spiculæ of snow in air. Light diffused. Illumination in sky lens-shaped.
" 2			76	26°	Overcast; no stars visible. Clouds apparently immediately above Galt, so that little or no light was visible, but from 20° upwards a bright and diffused band of light extended to the zenith and a little beyond. Laterally the band extended fully 90° on the horizon. At the same time in the northwest of the sky was visible at an elevation of 7° a band of illumined clouds, being reflected light from the electric lights in Berlin, seven and a half miles distant.
" 3	31°30′	10200	95	10°	Light clouds; stars visible. Light bright on clouds.
" 4			99		Snowing heavily, no light visible.
" 5			83	—2°	Moonlight; prevented observations for succeeding nights.
" 23			87	—6°	Bright starlight to within 5° of horizon. No clouds. Light so faint as to be indefinable in height.
" 24	37°	12400	88	8°	Sky overcast; fine snow; some stars dimly seen. Light diffused.
" 25	7°	2000	74	—2°	Starlight, but not very clear; no clouds, fog or mist on horizon although stars visible to within 10° of horizon. Light scarcely visible.
" 26			94		Heavy snow. Light invisible.
" 27			87		Too clouded.
" 28	32°	10300	90	31°	Misty.
Mar. 1	6°	1700	92	31°	Snowing. Light, a narrow band on horizon.
" 2	24°	7300	83	35°	Overcast; no stars. For 5° above horizon scarcely any light visible, then came a bright band which was diffused upwards, being more sharply defined beneath.
" 3	11°	3200		27°	Clear starlight, no clouds. Light faint and diffused, not much brighter than Milky Way.
" 4	12°	3500	82	32°	Sky overcast, but here and there a star visible. On horizon little or no light visible. From about 5° a bright band extended upwards, terminating rapidly; not much diffusion. Berlin lights, fairly bright band on horizon, elevation about 4°.
" 5			84	25°	Bright clear starlight. Aurora borealis in north, steady illumination, no streamers. Light almost invisible, just barely so on horizon; no elevation.
" 6	40°	13800	83	30°	Overcast. Immediately above horizon up to 4° no light visible. Above that to 7° was a cumulus cloud with rents; cloud, bright illumination, rents dark; above cloud diffused light up to 40.° Berlin lights visible on horizon upwards of 3° or 4°.
" 7			76	27°	Overcast. Moonlight, and hence no observations on succeeding nights.

NOTE.—In the above the word light is used for reflected light. Elevations given are never on clouds, and heights to the nearest hundred feet.

We have from the observations, therefore, the greatest height measured as something over three miles, and find that the fluctuation of elevation is very great, due mostly as before stated to the amount of moisture in the atmosphere. In every observation the reflected light must have travelled over at least three miles, passing obliquely from the higher strata of the air to the eye, so that we are correct in saying that the initial upward rays must have penetrated vertically more than three miles in every case.

But knowing that a ray of light penetrates at least a certain distance, and having an ocular demonstration thereof, are two very different things. A ray of light can itself not be seen, it is simply a direction of motion and has no material existence. Hence these upward rays would be invisible to us but for the existence of the air, with its aqueous vapor reflecting or turning some of these upward rays in such a direction as to fall upon our eye. If the image formed upon the retina of the eye is sufficiently bright, the impression of light is made upon the brain ; if the reflected rays are not sufficiently numerous to make that impression, no light will be visible.

This shows that two observers would probably not adjudge the same elevation in taking similar observations as the above, it depending upon the sensibility of the retina.

The more reflecting surfaces that we have the more light we will receive ; but when these do exist in the upper strata, they are in a measure also distributed through the lower strata, through which the ray must pass in order to reach us ; so that when the reflection increases, the transmission decreases, but in a less ratio up to a certain limit.

Through the kindness of the Director of the Meteorological Service, the figures in the column Relative Humidity were obtained They are for Toronto at 10 p. m. of each day. The comparative proximity of the place of observation to Toronto permits us to assume that the hygrometric curves of the two places are similar. Comparing the fluctuations from day to day of elevation and relative humidity, a foregone conclusion is substantiated, and that is, that although the elevation of reflection is dependent upon the amount of moisture in the upper regions of the atmosphere, that amount is not obtained by observing the relative humidity at the *surface* of the earth, nor is there a constant ratio connecting the two. The writer is not aware of any observations or tables that show the ratio of relative humidity for different temperatures, for different elevations above the surface of the earth at a given point.

In the summer-time during the heat of the day, the moisture is carried to higher regions increasing the relative humidity there, while decreasing the same near the surface of the earth; during the night when the air is being cooled off, the reverse takes place. In the winter it is not probable that the variation in a day of the relative humidity of the upper and lower regions is as great as in summer.

From a series of observations extending say over a year at least, we might hope to deduce a curve from the elevation observations, representing fairly well the hygrometric curve of the upper regions.

Should the above observations be compared with those at other localities, due consideration must be given to the number of lights, and their construction.

The greater the number of lights within a given area, the greater the illumination, and the higher the visible reflection.

OTTO J. KLOTZ.

GUNTER'S CHAIN.

Mr. President and Gentlemen,

I think that anything I may advance regarding Gunter's Chain will be quite familiar to you all; I would not have chosen it as the subject of an address, however short, to this Association, were it not that my attention was drawn to consider the great utility of this standard of measurement by some paragraphs in an article published in an exchange we received from one of our sister associations during the past year.

The article is entitled "Decimal *versus* The Metric System." As the Metric System is a Decimal System, the title appeared to be peculiar; on reading the article, I found that the writer wished to prove that it was advisable not to adopt the Metre, but to retain the Foot, decimally divided, as the Standard for American Engineers and Surveyors, and to discard the use of all other standards of measurement whatever, including Gunter's Chain.

The foot, decimally divided, is almost invariably used by Civil Engineers in our various surveying and levelling operations, and has been so used for a great number of years; I am of the writer's opinion that for this class of work it would not be advisable to make any change; I also agree with him in that it would be a great benefit if the foot, divided decimally, were in general use by architects and artisans, similarly with regard to the advisability of using the cubic foot also divided decimally. I am one of, I believe, a large majority who are of opinion that it would be a public boon to cease using the different weights and measures now in use, and to adopt decimal measurements of volume and weight of which the foot might be the base; but for measurements of areas it is different. I am of opinion that as long as a mile is a standard of length and an acre a standard of area, so long will Gunter's Chain be preferred by Surveyors for nearly all their measurements, and of areas especially.

The paragraphs to which I refer, are these:

"I wish to make a few comparisons, and will start with the statement that we must have a new system of notation in weights and "measures. We all remember our childhood school-days, trying "to memorise the complicated duodecimal system of weights and "measures, that made mathematics, the grandest and most exact "of all arts and sciences, a dread to the majority of scholars,

" a dislike that can be overcome by improving our system of nota-
" tion. I will take the Gunter's chain to start with:

" PROBLEM :—How many acres in a tract of land of the follow-
" ing dimensions: Gunter's chain, 6 rods, 1 link, 4.08 inches, by
" 26 rods, 10 links = ? Decimal, 100 feet, by 435.6 feet = 43,560
" square feet = 1 acre? Please note the chain measurement, use
" decimals of an inch, and the entire measurement will have to be
" reduced to decimals before multiplying, and then divided by 160 to
" get answers in acres. If you ask what is a rod, nine out of ten,
" if they know, will answer, sixteen and one-half feet, instead of
" twenty-five links. I think this simple experiment will prove to
" you all, that to use the foot instead of the Gunter's chain is not
" introducing a foreign element to anyone's detriment."

Please note especially that the writer takes Gunter's chain, which is in itself a decimal system, pure and simple, to illustrate the advisability of adopting a decimal system, and that he quotes the measurements taken with it in *rods, links, inches and decimals of an inch!* This is the first instance in my experience of a measurement taken with Gunter's chain being expressed in rods, links, inches and decimals of an inch. I think that eminent Astronomer and Mathematician, Mr. Edward Gunter, would have been astonished at such a liberty having been taken with the chain that he had the wisdom to divide decimally.

As we all know Mr. Gunter's invention or discovery consisted in having observed that the result of 5,280 feet, that is the length of one mile, divided by 66, is exactly 80, or as now expressed, 80 chains make one mile, and that 10 times the square of 66 feet exactly equals one acre, or, as now expressed, 10 square chains make one acre; there remained nothing therefore to do but to divide decimally the standard of 66 feet, thus discovered, which Mr. Gunter wisely did, dividing it into 100 links, and each link into tenths and hundredths, therefore the problem given in the paragraphs I have quoted, instead of being stated 6 rods, 1 link, 4.08 inches, by 26 rods, 10 links, should have been stated 1.5151 chains by 6.60 chains. But this problem, to put it mildly, is unfair and misleading, as one multiplier is made to express 100 feet exactly, and is therefore necessarily a repeating decimal, and obviously cannot be a measurement made with Gunter's chain. A fair problem is any one in which the multipliers are even such as:

2.25 chains × 5.50 chains = 1.375 acres and the equivalents in feet.

165 feet × 363 feet = 59895 square feet ÷ 43560 = 1.375 acres.

The measurement with the chain manifestly possesses the advantage of not requiring the division by 43560, which is quite an advantage when there are a large number of areas to be ascertained. Both of these answers are expressed in acres and decimals of an acre, as in this Dominion the expression of areas in acres, roods and perches has happily become obsolete.

We must not forget also that maps or plans, constructed with the scale referring to measurements made with the chain, possess a decided advantage over those made with the scale referring to measurements made with the foot as a standard; for instance, in a map or plan with a scale, stating that 10, 20, 40, or 80 chains equal one inch, we know at a glance that 8, 4, 2, or 1 inch, as the case may be, on the map or plan, is exactly a mile, and we also know that the map has been constructed decimally, whereas the equivalents in feet, 660 feet, 1,320 feet, 2,640 feet, or 5,280 feet, to an inch, are very inconvenient scales, and preclude the possibility of constructing the map or plan decimally; and if the map is constructed with a scale of even 100 feet, we still have the fraction of 280 feet in every mile to enter into the measurement of any distance on the map or plan to be expressed in miles.

In conclusion, I think there is no doubt that the Surveyors' chain, commonly called Gunter's Chain, which was invented by Mr. Edward Gunter about 250 years ago, is still at this date too valuable a link between the standards of a mile and an acre, and too convenient a standard itself for measurements generally and of areas in particular, to be lightly set aside for any other standard whatever, that is, as long as a mile is retained as a standard of length and an acre is retained as a standard of area.

S. BRAY.

OTTAWA, 1st February, 1889.

THE STATUS OF OUR PROFESSION.

This is emphatically an age of improvement. Since the commencement of the Nineteenth Century what wonders have been accomplished! The very elements have been made to do the bidding of man. He has harnessed the lightning—compelled the slumbering properties of matter to do his bidding. "He has made the wave a willing slave, to plow its own blue deep, and over the land, the rock and desert sand, with fiery train to sweep." Yet the man who acted as fireman on the first Railway Locomotive is still living, and is now a resident of Ontario! The uses to which electricity has been applied, within the last decade even, is simply marvellous. Had the announcement been made ten years ago that a person in New York City could hold converse with another in Chicago, whose voice and tone he could distinctly recognize, the man who made it would by common consent be considered a fit subject for the insane asylum; yet Edison has demonstrated this, and even more astounding discoveries, and yet the scale of progression increases in intensity at every new development. So eminently successful has been this victory of mind over matter, that the last leaf in the vast volume of research and discovery is in perfect keeping with the developments of the first.

Such thoughts are inevitable in glancing back through the long vista of past ages, in search of the object which has been most prolific upon this vast, almost uncontrollable, system of progression, and for the purposes of this paper the author hesitates not to assert that the science of the Surveyor has contributed its quota to this gratifying result, from the date Adam "surveyed the Garden of Eden roundabout" to the present time.

In complying with repeated requests, that I would prepare a paper to be read before the sixth annual meeting of the Dominion Land Surveyors Association, I may here premise that I do so with extreme hesitation, from the fact that the subject demands more time and attention than I can bestow upon it at present. I will, however, introduce the subject, leaving it for more extended treatment at the hands of the Association. The question to be considered at the very outset is what position should we occupy among the professions of the day? Do we occupy the place to which we are entitled? If not—why not? If imperfection exists and is admitted, the thing to be done is to ascertain the cause, and apply the remedy if possible.

That the profession of the Surveyor is entitled to rank among the first can be demonstrated by argument, as conclusively as it can be shown that we do not, at present, occupy the high position to which we are by right entitled, and which it is the aim of our Association to secure to us. The question of standing must necessarily be considered by comparison with the other learned professions—the Ministry, Law, Medicine, &c.—all of which have their several fields and special missions. It can be reasonably claimed that the theoretical portion of our profession affords a wider field for thought than can be found in any other profession. We have for a basis the most exact and absolutely correct foundation. The principles and correct applications of mathematical science admit of no uncertainty. No exceptions are necessary to prove the rule as in some other departments of science. In this respect we can fairly claim to be in possession of the only indisputably accurate profession; for do not ministers differ widely in their views, concerning even the fundamental principles which underlie the teachings and doctrines of the true Church? Doctors frequently differ on vital points pertaining to their profession; and in law, unless there are two sides, the interest in that profession would be greatly diminished. Thus we can readily see that while differences of opinion exist in other leading professions, ours, being governed by the unvarying principles of mathematics, must, when properly applied, produce correct results. The nearest approach to an apparent uncertainty in the study of our profession which I remember having met is the following:—"An asymptote of an hyperbola is a straight line drawn through the centre, which approaches nearer the curve the further it is produced, but being extended ever so far can never meet the curve." This may appear, at first sight, contradictory, but a principle similar to that upon which this depends is contained in the 47th Prop., 1st Book Euclid, from which it is shown that the square of the 2nd side subtending the right angle must be added to that of the other side, to equal the square of the hypothenuse. Now, to apply this principle, we will suppose the base to be one mile long, and the perpendicular to be one foot in length, the length of the base will be so nearly equal to that of the hypothenuse as to be practically the same; and the further the base be extended, while retaining the same unit of measure for the perpendicular, the more nearly will the base and hypothenuse approach to equality; yet, in the calculation we cannot ignore the perpendicular, however small the ratio, in order that a correct result may be obtained. Thus is demonstrated the absolute correctness of the fundamental principles enunciated. This principle also holds true when applied to calculations in spherical trigonometry and astronomy. By the aid of such principles we are enabled to explain why the moon, which is comparatively near to us (being about 30 diameters of the earth distant), appears as large as the sun, which is 400 times farther away. Were the moon to recede from the earth a distance equal to that of the sun, its diameter would be contained within an angle, which, at the distance of a mile, measures one inch and a half—half of which corresponds to the perpendicular or semi-diameter of the object viewed; nevertheless, this factor must play a very important part in calculating the sizes of the various planets, and all objects presenting a defined disc. This serves to give some idea of the care and skill that must be exercised, not only in the observations and calculations, but in making the instruments by which we are enabled to read such results.

Thus by the application of the principles of our science we not only measure the distances to the planets which compose the solar system, but are enabled to ascertain their relative size, position, velocity and weight. In illustration of this may be instanced the accuracy of the calculations involved in determining the exact time, locality and duration of the eclipse of the sun, which occurred on the first day of the present year. Not only was the moment of time accurately predicted, but so finely defined was the belt of totality, that its limits could have been marked out upon the earth by lines drawn across the continent. Astronomers made no mistake as to the location of points from which to make observations to the best advantage. This is but another illustration that the principles of mathematics, when properly applied, work out correct results, whether in the prediction of an eclipse of the sun or moon, transit of Venus, or other calculations in astronomy, spherical trigonometry, &c.

While the instruments and appliances for the prosecution of such extended investigations may not be within the reach of all, it is none the less requisite and necessary that we should be capable of putting to their proper uses the results obtained through these intricate appliances. By the teachings of our calling we are privileged to see, as "through a glass darkly," the operation of Nature's laws, and should be inspired by a desire to investigate still further this interesting and important branch of our profession.

In concluding this branch of our subject, it may be remarked that the mind can with difficulty conceive the extent and accuracy of the calculations involved. We quote figures without an adequate conception of their meaning. The distance to our nearest neighboring planet (Venus) is so great, that were we to travel by an imaginary railway train at an average rate of 30 miles per hour without stopping for wood, water or way-stations, we would only reach our destination at the end of one hundred years. The trip would thus prove a failure within the years allotted to the life of man. So much for the "all rail route" to our neighbors, the planets. Now let us consider for a moment the movements of light and electricity. The former comes from the sun in eight minutes, or 186,000 miles per second, and although travelling at that immense velocity we learn with astonishment that, had most of the fixed stars we view with the unaided eye been blotted out of existence at the date of our birth, we would be still able to observe them as if they had not been obliterated, as the light from them which now strikes the eye started on its course before we were born. It is only by such illustrations as these that we can gain anything like a comprehensive understanding of the immensity of the distances represented by the figures we employ, and with which we have to deal in the higher branches of our profession, to which every student should aspire.

In view of the nature and extent of the attainments necessary for those who would worthily uphold the dignity of our profession, it is reasonable to assume that our standing and influence should be second to none. But is it so? We have to admit that it is not, for reasons that lie upon the surface, and which we will consider briefly. We have allowed the profession to drift, as a craft without rudder or master, at the mercy of wind and wave. We have too long been without organization or association for the preservation or promotion of our interests. A few years ago, it is gratifying to note, leading members of our profession in the Dominion and in many of the States to the south of us, roused themselves, and a laudable effort was made culminating with us in the organization of the Association of Dominion Land Surveyors, which is doing good work in a right direction, and should receive the encouragement and active support of every member of the profession. The Surveyor, of all men, should recognize the fact that nothing in Nature can remain at rest, from the revolutions of the planets and heavenly bodies down to all animate and inanimate matter. Nature abhors a vacuum, and as well might we expect that a hole made in the waters of the ocean would remain unoccupied, as that our place among the professions can be kept and preserved for our use and occupation without active attention upon our part. Active and constant exercise is required, both of mind and body. The arm carried in a sling for a few months only will lose its cunning ; the profession or association whose members are inactive will similarly become weakened and incapable of effective action. To keep abreast of the times, we require a more constant and thorough interchange of ideas, and it is only by united action that we can hope to maintain our position, or prove to the world that we are worthy of recognition. At present in popular parlance, the Surveyor's whole staff, including the cook, is referred to as a "party of Surveyors," and what wonder, considering that from want of organization we ourselves scarcely know who are members of our profession qualified to practice. It is not surprising therefore that the public generally have fallen into the habit of considering as a Surveyor every person who can set up an instrument, read an angle, and chew tobacco, and occasionally strike the mark—with the tobacco juice. We owe it to the public as well as to ourselves, and the students who in good faith undergo the necessary courses to become surveyors, to weed out those parasites, whose monumental cheek enables them to usurp positions for which they have never become qualified, and who, being under no bonds, have the double advantage of assuming no responsibility. We require and should procure for our own protection, and that of the public, legislation more stringent than the laws at present operative. So long as we continue to allow unqualified persons to "*work at surveying*," we may expect to find the Courts accepting as professional such evidence as they may give. The lawyer and the judge naturally, and not unreasonably, look upon the matter only in reference to the facts to be adduced in the case, no doubt concluding that inasmuch as we allow such persons to practice as surveyors, it devolves not upon them to question their qualifications, or protect our profession against them. The truth appears to be that our profession, like that of medicine, requires protection. The latter profession has had of late years to institute the most rigorous prosecution of those who were unlawfully practising as physicians, and thereby bringing their profession into disrepute. The Surveyors' Association must do likewise, if they would protect the interests of the public and preserve their own respectability.

I venture the declaration that our personal habits have an important influence, and are largely responsible for our degenerate condition as a body. Our standing, individually and collectively, depends very greatly upon our every-day deportment. Our habits and customs have very much to do with the estimation in which we are held by the general public. The field practice of our profession tends to roughen our manners in many ways, and fasten upon us habits repugnant to polite society; hence if we would elevate our profession, we should exercise the greatest care in this regard. On extensive surveys we are to a great extent ostracised from the world and the advantages of more active society, which circumstance in itself has the effect generally of producing a carelessness of manner, which, taken in connection with our consequent lack of opportunities for the mutual interchange of ideas, all have a tendency to produce that carelessness and indifference which, perhaps more than anything else, affect our standing in the social and literary world.

Members of our profession are frequently being crowded out, and are driven to seek other employment, in order to procure a livelihood, while the work that should of right fall to them is being performed by those who are self-constituted surveyors, and presume to practice in direct violation of law. As I have already stated, the first practical work of the Association should be to discover and weed out of the profession such persons as are properly included in the term parasite. That being done promptly and efficiently, the status of our Profession must rapidly improve, till we take the place to which we are entitled among the learned professions.

J. W. HARRIS.

WINNIPEG, Man.

A STANDARD OF PRECISION.

As time adds to the experience of the surveyor, he becomes more and more convinced of the necessity of applying some test to each of the operations which go to make a complete survey, to ensure a satisfactory degree of precision; while an exacting public, imbued with the infallibility of the maxim "a penny saved is a penny gained," ignorant of the illimitable possibilities of error that beset the surveyor, and careless to an extent that is to be wondered at of the magnitude of the evils that may result therefrom, insists with increasing rigour on cheapness, and the necessary accompanying speed; indeed the idea seems to gain in popularity that the surveyor, like the fairy Puck, can "put a girdle roundabout the earth in forty minutes."

In the struggle for his daily bread, confronted on one hand by a strong competition, and on the other with an empty purse, what checks are indispensable to ensure good work? becomes a question of interest, and it has occurred to me would form a profitable subject for consideration by this Association.

A brief glance at the work of a traverse survey will present many of the various points of interest which the subject presents. The point of commencement (the location of which, generally depending on evidence, will not concern us here) having been satisfactorily determined, and the direction of the initial course marked on the ground, we have as the first instrumental operation to find its azimuth, involving at the outset the determination of the degree of precision of angular measurement, which the interests that may depend on the work require, that is to say—we have first to determine what quantities can be omitted from the readings, and second, the methods to be adopted for eliminating instrumental and other errors, so that each course may within a stated variation agree with its azimuth as recorded in the field notes. This limit of variation we may call our standard of angular precision. The precautions to be taken to ensure good chaining now require our attention. On this, the weak point of all surveys, those who have been engaged on surveys where check chains were used could perhaps give some useful hints. The error which should not be exceeded with the precautions determined on may be called our standard of lineal precision. Having in the various operations comprising the survey carefully conformed to the requirements of our adopted standards, we have in the errors of the closing angle and chainage, measures of the value of the work. If, for instance, we have decided to take the angular measurements to the nearest minute, with thirty seconds as the standard of angular precision, and have used those precautions considered essential for the elimination of errors, our closing error in seconds should not exceed the product of our standard of angular precision, thirty seconds, and the number of courses. Similarly the error shewn in the chainage of the last course should not exceed the product of the standard of lineal measurement adopted, and the sum of the measurements of all the courses. These quantities would have to be found by latitudes and departures in the field. The calculations can generally be made without delaying the other field work, and afford the additional advantage of locating and correcting an error, if any, before leaving the ground. The necessity of attention to this detail, particularly if the work is to have a guaranteed degree of precision, will be apparent. With judiciously framed standards, a departure from which would involve unnecessary minuteness and corresponding loss of time, or a gain in time at the expense of a probable inaccuracy, if not a downright mistake, the surveyor occupies unassailable ground.

If, in the event of a disputed survey, the surveyor can show satisfactory evidence as to the correctness of his work, his reputation will be enhanced, and the public will have an appreciable consideration for what might have been considered an unusual, if not an unnecessary, outlay for surveying. This evidence is afforded by our standards, when inserted with the result of the tests they supply, and a minute account of all the field operations in the note-book; for example—if the note-book of our supposed traverse, I mean the copy furnished with the plans as well as the field copy, records the bearings and distances corrected so as to balance, preceded by a statement of the standards of precision, and the data used for the determination of the initial azimuth, in the case, for instance, of an observation of the sun, this would be the latitude and longitude, stating how ascertained, time, registered declination, and instrumental readings, so that the calculation could at any time be checked, and all subsequent operations recorded with equal minuteness, followed on the last page with the closing errors and the deduced errors of each angle and linear unit, showing that the limits of the adopted standards have not been exceeded; confidence that could not be otherwise given to the work will be obtained. In those surveys where lines are to be run on stated azimuths, and the work terminates without the opportunity of making a satisfactory check, perhaps nothing short of two independent measurements will ensure entire confidence, but this on ordinary surveys is out of the question; still if the precautions adopted in the standards of precision are rigidly adhered to, their insertion will certainly increase the confidence with which they will be received. The importance of an individual standard being admitted, it is but a step to the adoption of a uniform standard by the profession.

A standard, having in view the objects I have endeavored to set forth and having the weight of a formal approval by this Association, would as they became known, if they would have any use whatever, be looked on as the hall-mark of reliable field notes. Plans when furnished without notes, but containing a certificate that the Association standard had been complied with in the survey, would also have an increased value.

In this paper I have not attempted to formulate any particular standard, but simply to suggest, by showing some of the advantages that would result, a consideration of the utility of the approval by this Association of some standards for use by its members, as a means of securing greater uniformity, increased confidence, and corresponding weight in subsequent discussions of surveys made by them.

J. A. KIRK.

STRATFORD, February 15th, 1889.

COAL MINING.

Mr. President and Gentlemen,

Through the kindness of your Secretary, I have been asked to prepare a paper on Coal Mining for this meeting, and after some hesitation, decided to give a brief history of the mining of coal in our Western Territories. Owing, however, to the short time available, I was unable to collect sufficient data, and therefore had to abandon the idea for the present.

A discussion on theoretic mining and the practical management of a mine are subjects upon which I feel inclined to touch but lightly, for various reasons; therefore the only other way in which I may occupy your time in discussing coal is on those branches with which all Canadians have occasion to be familiar; one for instance, coal as a means of brightening our firesides, looking into, of course, the financial aspect, and closing with a problem for the astronomical section, viz.:—

What change would be necessary in our solar system, so as to relieve us of the monotony of putting our hands into our pockets to settle coal accounts so frequently during our late autumn and early spring seasons.

Seriously, however, I will endeavor to give a short account of the mining of soft coals, based upon observations made in several mines during my connection with the Lethbridge Colliery.

There seems to be a prevailing idea among a great many, that the extraction of coal is a very lucrative business, one which requires little capital for the development of the mine, and yielding immense profits. One of the sources occasioning this error is doubtless the fact, that seams of lignite and coal are very often visible in the outcrops, along the valleys of our rivers; and to those contemplating the working of many of these seams, I presume the two principal factors entering into their profit and loss statements would be the contract price paid to miners, and a trifle for transport to market, leaving a very wide margin up to the selling price to the consumer. For the proper development of a mine, the first consideration of the Operator is a thorough examination of the coal area to be worked out, and a Diamond Drill, though somewhat expensive, is probably best adapted for this work, owing to its withdrawing a "Core" from the different measures passed through. The general dip of the seam may then be obtained, and shafts and surface works so located as to give the best combined results for the future development of the mine—for instance in underground-drainage, also underground-haulage with respect to grades.

Seams of coal may be found dipping from 0° to 90° and the nearer a horizontal position the easier worked for several reasons ; one I might give is the adaptability of such a seam for the introduction of mining machinery, of which I will speak later on. Rarely, however, is a seam found to remain level for any distance, being more or less undulating. Dipping seams, especially when they approach a vertical position, are often very uncertain, as in this position the seam may be most "faulty."

I have seen in the mountainous regions of Southern Montana abandoned coal mines, where in one case probably five hundred thousand dollars were expended in developing a vertical seam, to find that the coal ultimately disappeared. The percentage extracted of the total amount in the seam varies from 50% in some mines to 80% in others, and depends altogether upon the character of the roof. In many instances, in a mine with a soft roof, unfinished chambers have to be abandoned on account of the roof coming down, leaving buried large tracts of coal which would be too expensive to reclaim.

Props for the support of the roof are quite an item in the cost of production, and as the mine becomes developed the percentage of timbering increases, owing to the "entries," or arteries, through which the coal is hauled, daily becoming longer. In addition these entries require constant attention in the renewal of timbers. Then again in the chambers, the props are rarely reclaimed, unless in mines where the roofs are composed of good strong shales or stand-stones.

The manner of mining the coal is governed to a certain extent by its physical conditions. If the roof is very good, the system of long-wall work may be adopted with advantage. In this system a long continuous face of the coal is exposed, and by propping the roof along this face, sufficient room is secured for the workmen, behind whom the roof keeps giving way as the work advances.

The necessary roads through the working are usually supported by masonry.

The other method of mining the coal is by "pillar and room" or chamber workings, which to be applied in different seams require changes and modifications, depending upon the nature of the roof.

Under this system we have what is known as "double entries," which consist of two passages, each about 8 feet wide, and driven parallel with a pillar of coal between them, varying in thickness from 15 to 20 feet. From these, chambers or rooms are laid off, leading to the right and left from respective entries. These rooms are driven 9 feet wide, a distance of about 15 feet, when they are widened out to various widths consistent with the quality of the roof. Usually, however, with a fair roof, rooms 21 feet in width may be driven the full depth required, before the superincumbent mass is likely to come down.

The locating of the rooms along the side of an entry depends upon the maximum width of the room after it "turns the pillar," *i. e.*, where the width is increased, after driving the first 15 feet. Provision is made so as to leave a pillar of coal about 12 feet in width between each room, running its entire length, from which the coal is extracted backwards to within fifteen feet of the entry, after the room has been driven the required length. By this means solid pillars of coal of about 15 feet in length by various widths may be found along one side of the entry, and separated by the 9 feet entrances to rooms either worked out or under process of extraction, while the opposite side, with the exception of cross-drifts for air or roadways, is one continuous pillar of coal, separating the two entries. These pillars are left for the purpose of supporting the roof, and though 15 feet is mentioned herein as the usual distance, pillars extend back from entries, yet this does not follow in all mines, as the dimensions of pillars left for the support of roofs depend entirely upon the depth of stratification overlying the coal. "double entries" are necessary for ventilation. If the workings are on an extensive scale, the ventilating current is by mechanical means forced through one entry up to near the "face" or end of that entry, supplying on its way the several rooms ; then passing through a cross-drift, the other entry is converted into a return airway.

As the entries are driven forward, these cross-drifts are closed up, and new ones cut near the "faces," so as to ventilate the more advanced portions of the workings.

Should it be found necessary at any time to abandon any particular set of entries, the pillars then standing may be extracted backwards from the "face."

Some coals are much harder to cut than others, and owing to certain seams having a distinct clevage, with faces regular and parallel, the coal is much easier cut by working on or against the faces, making it therefore necessary to drive the entries on or against the "butts."

This is especially the case with the lignites and bitumens of north-western Canada.

The maximum depth of the rooms or distance between sets of entries is variable in different mines, and the management in defining this distance is governed by the quality of the roof, and also the greatest distance it is desirable to make miners shove their mine waggons out of the entry, from which point the waggons are afterwards hauled to the shaft or other outlet, by means of either horses, mules or machinery.

Rapid strides have of late years been made in the improvement of machinery used in connection with collieries, such as Hoisting Engines, Coal Cutting Machines, Drills, Mine Waggons, Tipples, underground haulage by means of endless chains, &c., &c.

Respecting Coal Cutting Machines, several forms have been invented, of which the "Legg" is probably the best in use to-day. These machines are operated by compressed air, which is conveyed into the mine through large wrought-iron pipes about 5 inches in diameter, and stored in reservoirs situated in different parts of the workings. From these reservoirs, permanent pipes carry the air forward, from which smaller and temporary ones, supplying the machines, lead to the various portions of the mine.

The object of storing the air in reservoirs is manifold; the supply from them being more uniform than if direct from the compressor, as the deep pulsations of the piston would be felt by the machines. It is supposed that the exhaust from coal cutting machines adds to the ventilation; however, in mines of any magnitude, the assistance rendered by this means is hardly appreciable.

Coal cutting machines are undoubtedly of great value to Coal Operators as the work they perform, viz., the undercutting of the coal, is that which would otherwise require skilled labor, so that wherever in use the management is not altogether at the mercy of labor organizations.

Apart from this, the machines—especially in mines where Long-wall work may be carried on—materially reduce the cost of production; but if the roof of the mine is poor, necessitating the driving of narrow rooms, then it is questionable if mining by picks is not as cheap, owing to the time lost in moving the machine from room to room.

In conclusion, it is hardly necessary to state that coal mining is becoming quite an important factor in the development of trade in the North-West. Mines already being in operation at different points along the Bow River from Calgary westward, also at Edmonton, Medicine Hat, Lethbridge, and on the Middle Fork of Old Man's River. Of course, some of these have not yet been developed to any extent, still the Colliery at Lethbridge may compare favorably with any in the Dominion of Canada, possessing as it does the latest improvements in all kinds of machinery requisite for the proper working of a mine.

It will therefore shortly be necessary for our Legislators to enact laws, governing the mining of coals in the territories, so as to insure safety against inexperienced and reckless miners.

C. A. MAGRATH.

LETHBRIDGE, N. W. T., 9th February, 1889.

A NEW FORM OF FIELD BOOK.

It was my intention to exhibit an improved steel band chain, made according to a design that occurred to me; but as there are no mechanics in that line of business where I live, and not having had time to make it myself, it still remains unmade. I now venture to submit to the Association an improved form of field book for Dominion Land Surveys, which is merely a modification of that now in use, for which I claim the following advantages: 1st. That the chance of error in ruling in a road is so much lessened, that it is practically reduced to nothing; 2nd. That as about half of the roads are printed in the blank, and that the half most difficult to rule in by hand, and also a good many of the signs to indicate "Post in Mound," the returns will have a neater appearance, and will be more readily made.

METHOD OF CONSTRUCTING THE BOOK FOR EAST BOUNDARIES.—Put in a road at the bottom of page 1, then one at the top of page 2, and so on for as many pages as there are miles of meridians in the township, the roads being at the bottoms of the odd pages, and at the tops of the even; and on the right at, say, $\frac{1}{10}$ of an inch distant from the ruled column, put a small N on the exterior line of the road at the bottom, and on the interior line at the top of the page; then, if the course of the line is north, N is on the side the meridian road is to be ruled, and on the line upon which the sign indicating "Post in Mound" stands; if south, S indicates the positions of the same.

FOR NORTH BOUNDARIES.—Put a road at top and bottom of the page, and (analogously to N and S on East Boundaries) put W on the exterior road line on the right of the ruled column, E on the exterior road line on the left, then when the course of the line is west, W indicates the side of the column upon which the road is to be ruled, and also the line on which the mound sign stands. When the course is east, E indicates the same.

The above holds good with one exception. In a township with a correction line on the south boundary, the mound sign will stand on the interior line of the road on the correction line.

N.B.—The words "exterior" and "interior" have reference only to lines in the book, the interior line of the road being that next the centre post.

It will be seen then that in addition to what is in the existing form, the following may be printed in the form I submit.

(1) All the roads at the bottoms and tops of the pages.

Township ...... Range ...... West of .... Meridian

East Boundary of Section .... Course: ....

P in M.

Alluvial soil

Depth, ... inches

Subsoil

Class ......

Class ......

Alluvial soil.

Section ......

M

Depth, ... inches.

Subsoil

Section ......

Class ......

Class ___

Alluvial soil:

Depth, ... inches

Subsoil.

S

N

The above line was run on the .... day of .... 188......

Township ......, Range ...... West of .... Meridian

East Boundary of Section .... Course: ....

S

N

Alluvial soil

Depth, ... inches

Subsoil

Class ......

Class ......

Alluvial soil:

Section ......

M

Depth, ... inches.

Subsoil

Section ......

Class ......

Class ......

Alluvial soil:

Depth, ... inches

Subsoil

P in M.

The above line was run on the .... day of .... 188......

Township ......, Range ...... West of .... Meridian

North Boundary of Section .... Course: ....

W

Alluvial soil

Depth, ... inches

Subsoil

Class ......

Class ......

Alluvial soil.

Section ......

M

Depth, ... inches.

Subsoil

Section ......

Class ......

Class ___

Alluvial soil:

Depth, ... inches

Subsoil

E

The above line was run on the .... day of .... 188......

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(2) The mound marks at the tops and bottoms of the pages for east boundaries, where there are no roads.

(3) The mound marks for the centre mounds.

(4) "*East*" (boundary) at the top of the east boundary pages.

(5) "*North*" (boundary) at the top of the north boundary pages.

Some five or six years ago a very neat form of field book was adopted, but only for a short time, owing to the following objection: the courses were printed in the blank form, and all lines had to be run in the field on the courses given in the book, otherwise the notes had to be invented, or the roads, etc., crossed out and others put in. The only trouble of this kind that could occur in the form I suggest would be, if say the east boundary of Sec. 2 were run north one mile, and the east boundary of Sec. 11 run south to meet it, page 1 will be found to answer for either line, but page 2 for neither, unless the notes be inverted. It follows then that meridians should be run consecutively for two miles, and I may say they are so run almost universally; but the surveyor is at liberty to run either north or south, as may be most convenient.

A. J. BRABAZON.

A PLEA FOR PIONEERS.

I wish to say a few words in defence of pioneer explorers and surveyors. We may excuse or pass over the ignorant remarks of those who are not supposed to know anything of the surveyor's work, or of the difficulties he has to overcome; but when criticisms come from those of our own calling, they deserve a word of notice. It is, perhaps, too common a failing to point out, and perhaps ridicule, the imperfections of the first attempts to map a new country. Does it ever occur to those who indulge in such presumptions of their own superiority, to ask themselves the question, could they do any better or indeed half so well if placed under similar circumstances?

It is no doubt true that the preliminary maps of a hitherto unknown district do sometimes contain singular and unaccountable errors. even when these have been the work of the most careful and conscientious men. When we remember that important points in regard to the construction of such maps depend on single observations, with no means of checking them, it is easy to conceive how such errors may arise, and how easy it becomes to rectify them afterwards when they have been discovered, and the means of correcting them have been pointed out. Where there is no check, errors may arise, similarly, in plotting work which is itself good. These are imperfections which should be leniently dealt with. Let us take the case of the first attempt to construct a topographical plan of a district which had before been a complete blank on the maps. The explorer, let us suppose, has met with sheets of water which may be parts of one large lake, or they may be all separate lakes; but he has received what he believes to be reliable sketches or descriptions of their positions with regard to one another. These representations may agree with his own opinion from the lie of the ground, and he so represents them on his sheet, doing the best he can with the limited time and means at his disposal. Subsequent surveys show him to be wrong, perhaps only in small matters of detail, and, forthwith, some wiseacre, who thinks all maps must be judged by the standard of those—say of the Ordinance Survey of Great Britain,—pronounces him as incapable, or a fraud. The same kind of errors may be made in the first efforts to indicate the branches of rivers in a new country; but surely the best possible, under the circumstances, is better than nothing. Even in the surveys of townships with good instruments, mistakes of the kind here indicated may occur, and they were certainly frequent enough—the surveys of our predecessors.

But in those days, good instruments were not so easily obtained, and the pay of surveyors was no better than their work. Referring to misconceptions about the connections of rivers, many of us will remember the case of the upper waters of the Maitland River in Ontario, which for a long time were believed to belong to the Saugeen, as their names to this day testify. Similar errors as to rivers have occurred in all new countries. What better could have been done until more light was obtained? It is easy to point these things out after they have been discovered, and it is seldom that those who are the most uncharitable could have done as well themselves. The work of early explorers is often a labor of love, and it is not to be supposed that those gentlemen, while they were working hard, and doing the best they could to map the country correctly, would put down errors on purpose. How much easier they have made the work for their successors. The latter are glad to take the fullest advantage of their labors, and by means of their maps, even with their imperfections, the way has been made clear for them, and they can see at a glance just what more is wanted. Even the mere indication of a route for travelling by, or getting in provisions, is often of great assistance. For these advantages the surveyors should be grateful, who are thereby enabled to get along in more comfort and lay out more accurate work.

Allowances must also be made for the compiler of other men's work. He makes the best use he can of imperfect or preliminary materials, relying most on what he considers the best; but after all, mistakes are pretty sure to creep in. The first man to compile a sheet, showing the connections of townships with all their lakes, streams, roads, &c., which were before only to be found in a disjointed form, on many sheets or many scales, does a good work, which for the first time enables us to see our way, as it were, through the country. Such a map is of constant use for reference, even in the process of compiling an improved one, and it would ill-become those who benefit by the use of such maps to sneer at them or ridicule their unavoidable short-comings. The very person who does so is probably the one who has found it most useful, and has perhaps based his own work upon it. It is always so much easier for the average man to find fault than to do the work better himself. Besides, he imagines he has an opportunity of calling attention to his own accuracy by crying down the supposed errors of others.

The best of our maps are imperfect, and the superiority of the more modern over the older ones is only a matter of degree. We trust the best maps of to-day will be superseded by better ones by-

and-by, and if we take into consideration our present facilities and the improved methods at our command, we deserve no more credit for our comparatively accurate or fine work than do the pioneers for their equally honest attempts to do the best they could in their generation. Map making is always a process of development or evolution, and even yet we may not fully realize the future possibilities of the art of representing topography on paper.

DR. ROBERT BELL.

HON. D. W. SMITH, FIRST SURVEYOR GENERAL OF UPPER CANADA.

MR. PRESIDENT AND GENTLEMEN,

During the year A.D. 1888, the Toronto Public Library received from England a number of manuscript volumes, now known in the Library as the Smith collection. They relate to the times of the Hon. D. W. Smith, the first Surveyor General of Upper Canada, who was appointed by Royal Commission, dated 10th of May, 1800, but who had been acting Surveyor General since the year 1792. My attention was first directed to the existence of these records by Mr. J. S. Dennis, D.T.S., who suggested that an interesting paper for our Annual Report of Proceedings might be got from them. I have attempted to do this, and now submit my work to your indulgence. The Smith collection then consists of private letters to Mr. Smith, council office letters, lots and locations; letters which he received, as head of the Surveyor General's office, with, in some instances, his replies, besides other documents illustrating the early history of Ontario. The contents of one volume are as follows:—

(1) Surveyor General's commission.

(2) Instructions of Surveyor General Smith to his deputies.

(3) State of the Surveyor General's office, July 1st, 1802.

(4) Several papers recommendatory of him, by the Parliament, the Duke of Portland, President Ruby, the Privy Council, the Chief Justice, Land Boards, Under-Secretaries of State, and Inspector General of Accounts.

(5) Correspondence with Brant, the Indian chief, and papers relating to the Five Nations.

(6) A proclamation, February 2nd, 1793.

(7) Several papers relating to the Militia and the Lieutenancy of the Co. York.

(8) Several papers relative to the culture of hemp in Upper Canada.

(9) Rules for preserving seeds.

After much debating as to what form my paper should take, I decided that the best thing I could do was to give a short introductory connected sketch of Mr. Smith, as derived from the Smith collection, and follow this by copies of some of the most interesting papers from the original.

The Hon. David William Smith was, it appears, the son of Lieut.-Colonel John Smith, of the 5th Regiment, and the earliest reference to him, in the Smith collection, is contained in a recommendation of him by the Detroit Land Board, in A.D. 1791. This document is addressed to Lord Dorchester, Governor General, &c., &c., and is essentially an appeal for an increase of pay to Mr. Smith, as clerk of the said Land Board. In 1792 Lieut.-Governor Simcoe arrived in Canada, and it appears that he desired immediately to inform himself as to the Surveying Profession, as witness the following letter of the Surveyor General of Quebec:—

"I have the honor to enclose a list of Deputy Surveyors, with "the date of their commissions, under your Excellency's command, "to the best of Mr. Collin's and my recollection, the book of record "having been mislaid. The gentlemen who have been employed by 'the Government have been paid up to the 10th of last April, "from which time they are considered to be on the Establishment "of Upper Canada, &c., &c.

"SAMUEL HOLLAND.

"QUEBEC, 7TH June, 1792.

"HIS EXCELLENCY LIEUT.-GOVERNOR SIMCOE,"

On October 27th, 1792, was issued this circular:—

"GENTLEMEN,

"His Excellency the Lieut.-Governor has thought proper that "David William Smith, acting Surveyor General, should in that "capacity have a seat at the several Land Boards." It would appear then that some time in the latter part of 1791, or the early part of 1792, Wm. Smith was appointed "acting" Surveyor General, although he did not receive his commission until the year 1800.

In a despatch to the Home Government, dated February 28th 1794, Governor Simcoe refers to Mr. Smith. He says:—"His "Majesty's service has been essentially promoted by Mr. Smith, "late secretary. * * * * I have appointed Mr. Smith, a very "able gentleman, whom I have the good fortune to meet with, to "act as Surveyor General."

Here are, also, two extracts from Chief Justice Elmsley to Mr. Smith:—"It can hardly give you more satisfaction than it has me, "to hear that though I have heard every other officer in the Land "department complained of, I have not heard the smallest complaint "of you, and I believe your Deputies give great satisfaction."

After this introduction, our acquaintance with Mr. Smith is kept up through the record of his official correspondence. This is somewhat of a fragmentary character; but from it we make out that Mr.

Smith must have been very much a man of affairs. In 1797 he was nominated by the Indians of the Five Nations as one of the Trustees of the funds, to be derived from the sale of certain of their lands on the Grand River, an office which must have engrossed a good deal of his time, and caused him much solicitude. He was also an officer of Militia, being Lieutenant of the Co. York, as the following circular will show :—

"NIAGARA, 8th August, 1796.

"SIR,

"His Majesty having been graciously pleased to call me to the "administration of this Government, during the absence of His Ex. "cellency Lieutenant-Governor Simcoe, who is returned to Europe, "with leave for the recovery of his health, I have the honor to "communicate my appointment to you, and to request from you "every information which you may judge to be conducive to the "welfare of this Province. The Militia of your County being "peculiarly under your direction, I am to desire that you will use "without delay the best means in your power for carrying the "existing Militia laws into execution, and of obtaining lists of "all the persons therein who are capable of bearing arms, and that "you will form them into companies and battalions according to the "act. The Militia Act having vested you with a power of appointing "officers, you will be pleased to fill up all vacancies, and give me a "return of the names of the officers in each battalion. I shall "be glad to be informed what Protestant churches have been "erected in your District, and how they are served, and be pleased "to turn your attention from time to time to the Interior Govern- "ment of your County. And when you find magistrates wanting to "the suppression of vice and immorality, and the due execution "of the laws, you will recommend to me such persons as you may "judge qualified to be added to the Commission of the Peace. It "may be also proper that you recommend it to the Justices of the "Quarter Sessions, to report to me the state of the Prisons, &c., &c.

"You will find me at all times ready to attend to every measure "which you may recommend for the benefit of the District under "your charge, as it ever will be my ambition and pride to contri- "bute all in my power towards the organization, good government, "and prosperity of this infant colony."

(Signed), "PETER RUSSELL,
"*President Administering the Government.*

"Hon. D. W. Smith,
"Lieutenant of the Co. of York."

Mr. Smith accordingly furnished a statement of the condition of the First Regiment of York Militia, giving the names, residences, &c.

Under date of April 1st, 1799, Mr. Smith receives another circular letter from President Russell, asking for "a list of the gentlemen "residing in the County over which you preside, who are in your "opinion fit to be honored with His Majesty's Commission of the "Peace. * * * * * * My reason for addressing the Lieu-"tenants of Counties on this occasion is, because it is impossible to "know the merits or demerits of the inhabitants of the Province "who live at a distance from the seat of government, in conse-"quence of which ignorance many persons are made Justices of the "Peace, who are by no means proper for that high and important "trust, and others who are not only qualified for that office, but "might do honor to any other, are left out of the Commission. To "do justice, therefore, to the Province, and obtain reputable "Magistracy, I call upon the Lieutenants of Counties to assist "me in this selection. And as men of honor, and zealous in "promoting the welfare of the county they live in, I have a right "to expect they will be guided altogether by the above principles "in the recommendations they shall make to me. * * * *

(Signed), "PETER RUSSELL,
"*President, etc.*

"The Hon. D. W. Smith."

The following letter will be understood without the help of comment:

YORK, 17th July, 1798.

"SIR,

"I am extremely sorry for the occasion which has obliged you "to solicit my permission to go to Newark, and I sincerely hope "that my compliance with your request may be the means of restor-"ing Mrs. Smith to her former health. * * * * * * * * "I own it will be with reluctance that I consent to your absence "from home until 1st of October, because the Chief Justice's judi-"cial duties will probably keep him away until that time, and I "cannot depend on Mr. McGill's assistance as a councillor, as his "employment of Agent for Purchasers is constantly calling him from "home. * * * * * I really see no probability of my being "able to collect a Council for any purpose, and the whole business "of the Province must be at a standstill until your return. * * * * * * * * *

(Signed), "PETER RUSSELL.

Hon. D. W. Smith,"

From all which it would appear that the duties of the Surveyor General in those days were of a very varied and multitudinous character, and with a little exaggeration, Mr. Smith may be said to have been "The Father of his Country." As already stated, Mr. Smith had been discharging the duties of Surveyor General from the year 1792 until 1800, without been confirmed in his office, or, as appears from one of the following extracts, receiving any higher salary than that of a Provincial Surveyor, a state of things not at all creditable to the Home Government, as the subjoined extracts will show that the matter had been brought under their notice.

The Duke of Portland to Mr. President Russell.

"I will take an early opportunity of communicating with Major "General Simcoe on the subject of Mr. Smith's memorial. The "merits and services of that gentleman are certainly entitled to "immediate attention, and I will inform you of the result by the "next packet.

(Signed), "PORTLAND.

WHITEHALL, 11th September, 1797."

Yet it was more than two years and a half afterwards before Mr. Smith received his commission, notwithstanding that he brought the most powerful influence in the Province to bear, in his behalf, as appears from what follows:

His Honor Mr. President Russell, administering the Government of Upper Canada to His Grace the Duke of Portland.

"YORK, 12th February, 1799.

"MY LORD DUKE,

"Mr. Smith is a most useful and deserving officer, and indefa-"tigable in his attention to the Department of Surveyor General, "over which he has for some years presided with no other salary "than that of a Provincial Surveyor."

"LEGISLATIVE COUNCIL, 28th June, 1799.

"*Resolved unanimously*,

"That the thanks of this house be given to the Hon. D. W. Smith, "acting Surveyor-General of this Province, who is now about to "return to Europe, as a mark of the very high sense which this "House entertains of the ability, assiduity and unblemished inte-"grity with which he has for seven years past discharged the duties "of that important office, and that the speaker do communicate the "same to him without delay."

It does not appear, however, that they voted him any money.

(Signed), J. ELMSLEY,
Speaker.

N.B.—The thanks of the Lower House are in similar words, and the resolution was passed on the same day.

A minute of Council, dated York, 11th July, 1799, recommends that Mr. Smith's memorial for leave of absence to go to England should be granted, and makes flattering references to him.

Mr. Smith it would appear then proceeded to England in 1799, and of course one important object of his mission would be the securing of his appointment as Surveyor General. He would take with him his testimonials, of which he appears to have possessed the following, in addition to those alreary given ; before giving these, however we will first give extracts from his instructions to his Deputies for their guidance during his absence :

Instructions to William Chemett, Esq., Senior Surveyor and Draughtsman, and to Mr. Thomas Ridout, Principal Clerk in the Surveyor General's Department, Upper Canada.

"SURVEYOR GENERAL'S OFFICE, 17th July, 1799.

"GENTLEMEN,

"It being necessary, on account of my private affairs, and for the "perfect restoration of my health, that I should for a time absent my-"self from the labors of my office, and return to Europe, it affords "me great satisfaction and ease of mind that I have two gentlemen "in the department, whose merit, ability and integrity are such as "to entitle them to my fullest confidence, in the delegation of a "trust of such onerous importance as that of presiding over the "surveying department of this Province. To ye gentlemen jointly "do I delegate the office of Chief Surveyors of lands, acting as "Surveyor General, to be executed for me in the same manner that "I now execute it, with full power over the other branches of the "department, so as to enable you to carry all the orders of the "Executive Government into execution with promptness, as well "as you may have it in your power to regulate the official economy "of the office with ease and certainty. In the execution of this "business, you cannot be too scrupulously exact in complying with "whatever directions may be sent to the office for your guidance, "and at the same time that your endeavors employed more "immediately for Government, you will not forget to pay attention "to the calls of individuals, the satisfying of whom I have "always considered as essentially promoting His Majesty's interests "and the credit of the office. You will avoid all verbal communi-"cations as much as possible, and when you are obliged to act on "no better authority, you will make a minute of the transaction in "one of the books to justify your recollection, and to prevent mis-"construction afterwards. * * * * * * * * * * *

" The stationery is to be used with frugality, and the covers of all " letters laid into some niche to serve for scrawls and calculations."

Then follow instructions about certain plans that are being made, and documents in the office that need attention; then he proceeds: "I have no doubt but you will be actuated by the " same principles which have uniformly influenced me in the discharge of my duty. The office is to be regularly attended to " from ten o'clock to three, and when you are not there the doors " and windows are to be kept shut, and the fire left safe.

" The urbanity I have always observed in your manners and dispositions renders it unnecessary for me to say anything in detail " on the propriety and the necessity of civility and attention to all " persons who have business with the office, whether personally, by " letter, or attorney, as well to those whose appearance indicates " nothing but poverty as to those whose station, situation or character demand respect.

" I shall conclude these instructions with my hope that you will " lay your shoulder to the wheel, and strenuously exert yourselves " for the honor of the King's Government, the good of the public, " my credit and safety, and your own reputations, and I cheerfully " look forward from the product of my own labors, now in the " Secretary's hands, to be able to remunerate you for the additional " trouble, and I hope interest, you will have in the discharge of my " concerns, and so I bid you farewell.

(Signed), " D. W. SMITH,
" *Chief Surveyor of Lands.*
" Assist. Surveyor General, Upper Canada.

" To Wm. Chemett, Esq., Senior Surveyor, and
" Thos. Ridout, Esq., Principal Clerk, Surveyor General's Dep't."

18th July, 1799.

PRESIDENT RUSSELL TO THE DUKE OF PORTLAND.

" I am sensible that the loss of Mr. Smith's abilities will very " soon be felt, etc., etc........ ....As he will be charged " with my present despatches to your Lordship. I beg leave to " refer your Grace to him for whatever information you may be " desirous of receiving respecting Upper Canada, and I humbly " take the liberty at the same time of recommending him to your " Grace as a most zealous, active and intelligent officer, very highly " deserving from his signal services to this Province of your Grace's " protection and favor.

(" Signed), " PETER RUSSELL."

QUEBEC, 26th October, 1799.

"SIR,

"General Hunter desires me to acquaint you that he has recommended you both to the Duke of Portland and Mr. King, Under-Secretary of State, in the strongest manner.

(Signed), "W. HURREY,
"*Aide-de-Camp.*"

GENERAL SIMCOE TO MR. KING.

3rd December, 1799.

DEAR MR. KING,

I have already mentioned to you the services of Mr. Smith, and have now at his desire furnished him with a representation on that subject to his Grace the Duke of Portland. There is not a more valuable man in the service—in fact, he ought not to wither in Canada—you cannot patronize a more valuable man, his recommendations are from all that is valuable in that country; serve him, and you may eventually serve this country * * *

(Signed), GOVERNOR SIMCOE.

Governor Simcoe, at this date, was flourishing in England instead of withering in Canada.

At length Mr. Smith's commission was issued; although a somewhat lengthy document, I think it will bear reproduction here.

THE COMMISSION.

GEORGE R.,

George the Third, by the Grace of God, of Great Britain, France and Ireland, King, Defender of the Faith, and so forth.

To all to whom these presents shall come, greeting:

Know ye that we, reposing special trust and confidence in the ability, care and integrity of our trusty and well-beloved David William Smith, Esquire, have nominated, constituted and appointed, and by these presents do nominate, constitute and appoint him, the said David William Smith, to be our Surveyor-General for the measuring, surveying and setting out of lands in our Province of Upper Canada, in America, with power to the said David William Smith to do, execute, or perform, by himself, or his sufficient Deputy or Deputies, all things whatever belonging to the said office. And we do hereby charge and require the said David William Smith, his Deputy, or Deputies, in the exercise and execution of the said office, to observe and follow all such orders, rules and instructions as we, or the Commissioners of our Treasury, or our High Treasurer, or our Commissioners for Trade and Plantations, for the time being, shall in that behalf from time to time see fit to order, direct and appoint.

And all our Governors, Lieutenant-Governors, Commanders in Chief, and others, our Officers and Ministers whatsoever, within our said Province of Upper Canada, are to take notice herein, and to be aiding and assisting unto the said D. W. Smith, his Deputy or Deputies, in the due execution of the said office, in all things as becometh, and for the encouragement of the said D. W. Smith, well, truly and intelligently to execute and perform the office and trust hereby reposed in him.

And in reward for his care and labor therein we do give, grant and allow unto him, the said D. W. Smith, the sum of three hundred pounds per annum, to commence from the first day of January, 1800, and to be payable for and during his continuance in the due execution of the said office, or until directions to the contrary shall be given by us or by the Commissioners of our Treasury for the time being, an entry hereof being first made in the office of the Auditor and Surveyor-General of our Reserves in America.

Given at our Court of Saint James, this 10th day of May, 1800, in the 40th year of our reign.

(Signed), W. PITT,
" S. DOUGLAS,
" CHARLES.

David William Smith, Esq.,
Surveyor-General of Lands in the Province of
Upper Canada in America.

Mr. Smith remained in Canada about two years after his return from England with his commission; and again under date of July 17th, 1802, we find him preparing for another trip to Europe, by giving instructions to his Deputies as on the former occasion. We have space for only one or two extracts.

* * * * * * * "You will be very particular in the receipt of "fees, and take care that no other or greater sum be taken from "the public than 1s. 6d. for every search, and 1s. for the entry of "papers not exceeding 100 words. * * * * * * If any person "shall come expressly to town in order to obtain a deed, you will "further his business, all that in you lies" * * * * * continuing "a courteous behaviour to the public, a steady application of your "labours and time to the duties of the Department * * * * * * "You will take care that the Field Surveyors, should any be

"employed during my absence, make a proper use of their time, "and that neither their parties nor themselves are borne upon the "pay lists longer than they are naturally employed."

Mr. Smith did not return to Canada, this it would appear was due to ill health. It would appear also that he had been endeavoring to procure a pension in England, or something of that sort; the following letter bears on the question:

WHITEHALL, 26th July, 1803.

"DEAR SIR,

"I shall always be happy to give my testimony of the utility of "your public services, and ready as far as in my power to promote "your reasonable representations to public remuneration.

(Signed), "J. KING."

Under date of Downing Street, 29th April, 1804, the Under-Secretary of State writes to the Treasury on behalf of Mr. Smith, and prays that "some provision may be allowed to him in this country upon his relinquishing his office in Canada;" this was an account of Mr. Smith's ill-health, and the Under-Secretary asks that in case he cannot resume his office in Canada, that an allowance of £200 per annum be given him. He never did come back to this country, but became estate agent to the Duke of Norfolk for about 40 years.

The Smith family owned a large area of land in Upper Canada, over 20,000 acres altogether. Of this the Surveyor General had 6,400 acres, besides 200 acres of park lots. His five children are down for 1,200 acres each. Col. Smith, his father, "drew" 5,000 acres, his wife had 2,400 acres, and their daughter Miss Anne, the balance of the 20,000.

Among the Smith collection is a volume 16″ × 12½″ × 1″, containing plans and descriptions of these lands, and entitled the "Smith Estates in Canada." There is a preface consisting of a dedicatory letter, dated at York, 28th April, 1802, signed by W. Chemett, Senior Surveyor and Draughtsman, which informs us that the said volume was compiled by Mr. Chemett, and presented to Mr. Smith. There are no courses or distances written on any of the plans, nor is any scale mentioned. The water colors do not appear to have faded at all, except the blue, perhaps. The lake, as it is called in an "explanation of the colors," is evidently as bright as it was when laid on. It looks like our carmine. These lands are scattered through nineteen townships, and the towns of York and Niagara.

A very interesting document is the one giving the state of his office on 1st July, 1802. Of surveying instruments we note "A "theodolite with vertical arch and telescope, legs, etc., etc.; an "old theodolite, a leveling instrument with legs and case.

"A Pentographer with case.

"A Gunter's chain.

"A large copying glass.

"A drawing frame.

"An old barometer.

"One case of instruments, new."

A great many plans and atlases are enumerated, among which the following are noted:

Plan of Kingston Harbor, with the heights of ground expressed in figures.

Plans of Meridian lines erected at Johnstown and at Malden respectively.

Plan of the Town and Fortifications of New Orleans, and Batteries on the River Mississippi.

Plan of Lake Huron, Rapids of St. Marys and Matchedash, supposed to be from Colonel Munns, Royal Engineers.

Plan of the Strait and Fall of St. Mary's, by De Pencier, under directions of Lieut. Brice, R.E.

Plan of the North side of Lake Ontario from Cataraqui to Niagara.

There are mentioned also three documents in reference to the Division Line between the Provinces.

Mention is made of Field-notes and of Meteorological Observations; also of Diaries, Volumes of Letters, Warrant Books, Schedules of Locations, Descriptions, Doomsday Schedules, Oaths of Allegiance, Scrawl Plans, Blotters, etc., etc., etc., but our space will not permit any more citations.

We shall conclude with a few letters from his correspondence. Most of the letters preserved in the collection are letters which he received, there being very few of those written by him. The most interesting are those from Captain Brant, the great Indian Chief.

"GRAND RIVER, April 3rd, 1796.

"DEAR SIR,

"As I understand the council are to meet at York the 5th inst., "I take the liberty to acquaint you of the present situation of "Indian affairs here, and more particularly in the westward. Our "former acquaintance inducing me to take that freedom, and more "especially as it lies in your line of business. I am sorry to find, "by repeated informations during the winter from Detroit, that "Mr. Aikens and some other merchants have been seducing several "Indians to make over the lands to them. Last summer they "began to set this agoing, and it was they who prevented our "meeting taking place previous to the Indians going to Wayne's "Treaty. They have now engaged in a company to get from the "Chippewans, all the Wyandotte and Mingo people from Kaihope "upwards. If the English Government do not take some means "to put a stop to these proceedings of their subjects, I am apprehensive it may occasion some confusion among the Indian Nations. "It is certainly very hard for poor Indians that what land Wayne "left them, these fellows with their rum will endeavor to strip "them of; and Mr. Aikens has expressed himself in such a "manner as shows he would make no scruple to endeavor to "excite a war among the different nations, to answer his selfish "purposes. You well know that Sally Ainse's land was her right "before the purchase was made by Government, and that the "Land Board cut it in pieces afterwards; since, it has been promised, in presence of the Five Nations, to be restored to her, and "is not restored; yet, notwithstanding, I really must confess that I "begin to think it too hard to see our friends the English so very "strict about Indian lands, as for instance the great trouble we "have had about this land here, and yet cannot learn whether it "will end to our satisfaction or not. It grieves me to observe that "it seems natural to whites to look on lands in the possession of "Indians with an aching heart, and never to rest till they have "planned them out of them.

"Dear Sir, I am with respect,
"Your most obedient and humble servant,
(Signed), "JOSEPH BRANT.

"Captain D. W. Smith."

"HEAD OF THE LAKE, Dec. 15, 1797.

"DEAR SIR,

"It having been deemed necessary that Trustees should be "appointed on the part of the Five Nations, I take the liberty of "naming you as one, which I do with the greatest cheerfulness, "on account of your private as well as public character, and "which I hope you will do us the honor and satisfaction of "accepting.

(Signed), "JOSEPH BRANT.

"Captain D. W. Smith."

The Surveyor-General wrote a long letter in reply; we give two extracts.

"York, 22nd Dec., 1797.

"Dear Sir,

"I have duly received your letter of the 15th inst., intimating a "wish to appoint me one of the Trustees on the part of the Five "Nations; not having had the pleasure of any conversation with "you on the subject of the Trust, to be committed to persons to "be appointed for that purpose, or that you intended me for one, "I am almost as much at a loss as you confess yourself to be. I "should suppose, however, that those who delegate the trust can "only say what that delegation should be, or to what extent it is "intended * * * * * * * On the score of the Trust, all I can "say is that as far as any mental labor or personal attention of "mind, which may be consistent with my public duty to the King's "Government, you may command on the part of the Five Nations, "if in the execution of said Trust I may not be liable to be called "from the seat of Government where my ordinary duty obliges my "constant attendance, and saving to myself the power of resignation in case of not coinciding in opinion with the other Trustees "(whom I do not yet know), on points which may be agitated "concerning your interests.

"I beg to assure you, dear Sir,
"That I am very truly your humble servant,

(Signed), "D. W. SMITH.

"Captain Joseph Brant,
"Grand River."

Brant thanks Mr. Smith for his acceptance of the Trust in the following terms:

"Head of the Lake, Dec. 28th, 1797.

"Dear Sir,

"I am very happy in the receipt of your favor of the 22nd inst., "which was handed me last evening by the Chief, who had it in "charge, and I can but express on behalf of the Five Nations the "very great satisfaction I enjoy in your obliging acceptance of the "Trust I have wished you to take on their behalf. Permit me, Sir, "to say that the great confidence I have in your abilities, integrity "and honor, renders us peculiarly happy in this acceptance, and I "am well satisfied to have it attended with the conditions you "have been pleased to mention * * * * * *

(Signed), "JOSEPH BRANT.

"Hon. D. W. Smith."

There appears to have been much misunderstanding between the Government and the Five Nations, in regard to the lands of the latter, and in the following letter to the Surveyor-General from President Russell, Brant comes in for a certain amount of censure, and even Mr. Smith does not wholly escape a mild rebuke, the single instance in which any fault is found with him. The great personal friendship which evidently existed between himself and Brant may have betrayed him into a weakness, if he were to blame at all, for the testimony at hand does not enable us to decide, but even at the worst it is clear that "even his failings leaned to virtue's side."

"YORK, 10th March, 1798.

"SIR,

"I have read the extract you send me from Mr. Stegman's letter "of the 7th inst., and your letter to Captain Brant in consequence, "on which I will only observe that you appear to me to have been "rather too mild for the occasion. With respect to the lands "appropriated to the Six Nations on the Grand River, we must "never lose sight of the letter as well as the spirit of Sir Frederick "Haldimand's Instrument by which they hold it. That Instrument "gives them possession of the lands 6 miles on each side of that "River from its mouth to its source. The courses of those boundaries were long since determined with Captain Brant and the "other chiefs in council with the Land Board of Nassau. They "were afterwards agreed upon and settled between General Simcoe "and that chief, and they have been again surveyed during my "administration, at his particular request, by two surveyors chosen "by himself, for which assistance I received Captain Brant's unqualified thanks. I am, therefore, not a little surprised that Captain "Brant should, without previously communicating with you or "asking my permission, employ a private surveyor, who has been "neither examined, licensed nor sworn, to trespass on the King's "lands, by entering them without authority, and setting up survey "marks to confound those of the boundaries before established. "Had Captain Brant conceived that there were any mistakes in "former surveys, he should have addressed the Executive Government to have them rectified. Wherefore if the information you "have received should turn out true, I must desire that you will "write to Captain Brant to desist, until he shall have explained to "me what complaint or objection the Six Nations may have "against the boundaries agreed upon. If Mr. Cockerel or any "other surveyor presumes to act as a surveyor in this Province,

"without a License for so doing, I shall direct the Attorney-
"General to proceed immediately against him by information.

"I have the honor, etc., etc.,

(Signed), "PETER RUSSELL.

"Hon. D. W. Smith,
"Etc., etc., etc."

The following is from the beginning of a letter from Captain Brant to Mr. Smith, on the occasion of the latter's return from England.

"GRAND RIVER, 19th September, 1800.

"DEAR SIR,

"From the friendship you have ever been pleased to show us, "we cannot omit expressing the particular satisfaction we feel at "your safe return from the other side of the water, on which we "sincerely congratulate you. Further, your arrival is particularly "satisfactory as concerning our affairs, of which as a Trustee we "will take the liberty of consulting you." * * * *

Brant and the Surveyor-General appear to have been on terms of intimate friendship, and the latter was evidently very warmly interested in the welfare of the former, and in that of the Five Nations generally.

The following is from Captain Brant to Mr. Smith, in reference to the education of Brant's sons :—

"GRAND RIVER, 20th September, 1800.

"DEAR SIR,

"I have very seriously considered the petition to His Grace the "Duke of Portland for the education of my sons, which your "friendship for me prompted you to advise me to make, and I must "acknowledge the particular satisfaction I feel at this further "instance of your inclination to serve me with your friendly "advice, as I am confident it must have been suggested to your "mind from the most friendly motives, of which I have had suffi-"cient proofs since our acquaintance. But I am sorry I cannot "altogether comply with your opinion on this point, for consider-"ing the many oppositions I have met with since the establishment "of the Government of this Province, in obtaining what I only "considered as our rights, and which indeed seems yet in some "measure undetermined, I cannot flatter myself with any prospect "of succeeding in asking such a particular favor. I therefore "decline, purely from the apprehensions of having my feelings hurt "by a refusal. Notwithstanding, I think such a thing being granted "would be extremely for the good of my family, and give me heart-"felt satisfaction could it be obtained for me by my friends, "without me running the risk of meeting with further rebuffs."

In a letter to Brant, dated 1st November, 1800, Mr. Smith regrets the decision of the Chief in the following language:—

* * * * "I cannot sufficiently lament that you have not followed "the advice I gave you in regard to your sons, as I had no view in it "but the uniform regard I have ever had for you and your nation."

It is with great reluctance that we take leave of Hayendanagea, but the limits of our space will not permit our further quoting him. His letters show him to have been a cultured, high-bred gentleman, and a collection of them would make as interesting a volume as anything of the kind that has ever been published.

This is the appropriate place to give extracts from some descriptions signed by Brant, in the Smith collection; no doubt they were drafted by some deputy surveyor, they are specimens of indefiniteness.

"Commencing at a white oak tree, marked and standing at the "southwest angle of the Reserve, made by the Indians on the East "side of the Grand River below Dickenson Creek. * * * *

"Hence S. 0° 31 E. to a basswood tree on the shore of Lake "Erie, near the mouth of a small creek, 514.00 chs. +

"Commencing at a post about one mile distant from the mouth "of a small creek called Chisholm's Creek, measured on a north "course therefrom, which said Creek falls into the Grand River on "the Eastern side thereof, about a quarter of a mile below a certain "pinery.

"Commencing at a point of land which constitutes the fork of "the Grand River, a small distance to the northward of Dundas "street." * * * * * * * * *

As already stated, some of the volumes of the Smith collection are collections of Council Office Letters, etc.; many of these are directed to the Surveyor General's Office, on matters relating to the taking up of land by different people, some being from U. E. Loyalists.

The usual procedure for obtaining Government land in those days would appear to have been to make application to the Council, sign a certain "Declaration," and take the oath of allegiance.

The following is from an application by a U. E. Loyalist. * *

"Your Memorialist carried provisions from his father's house to "the Rangers during the war, at the risk of his life, and in conse-

"quence of his attachment to the British Constitution and Govern-"ment, he was imprisoned for two years in close confinement, and "left all he had to the amount of £300," then after reciting the fact that land had been promised him, he goes on to ask that he may receive it, and that he may be treated like other settlers, and be put " on a reputable footing, having nine children being now in "a situation to cultivate, having good team and Memorialist's sons "able to work and carry arms. Your Memorialist fled to this Pro-"vince as soon as he escaped from jail six years ago. Your "Memorialist had five brothers who fought and suffered for the "King."

One or two extracts more, and we have done.

"COUNCIL CHAMBER, YORK, 10th July, 1796.

" Resolved upon the motion of His Excellency the Lieut.-Gover-"nor that the Order of Council of 23rd July, 1793, as far as relates "to the granting of one thousand acres of land to Lieutenant "Mayne Duncanson, be rescinded, he having become a citizen of "the United States, and that the same be kept open for other "applicants.

"J. SMALL,
"*Clerk.*

(An extract from Minutes.)

PAY OF SURVEYORS.

"I am directed by the Hon. the Chairman (to desire) that you "will please inform this Board by what authority the Deputy Sur-"veyors were continued at ten shillings per day when not in the "field, etc.

" J. SMALL,
"*Clerk.*

"Council Office, 19th August, 1800."

CONTEMPT OF COURT ! !

"DEAR SIR,

"I am directed by His Honor in Council not to locate (from any "recommendation), Justice Lovie, for his improper conduct before "the Board.

"J. SMALL."

With this we bring this sketch of the first Surveyor General of Upper Canada to an end. It is necessarily imperfect from the fragmentary nature of the sources of information. It is perhaps of less interest to us as Surveyors than as Canadians, for surveying was then in its infancy, and in Canada especially the compass and chain was the universal outfit. In the document already referred to as giving the state of his office, a theodolite is indeed mentioned, but probably this instrument was used only for laying down meridian lines at a few places, to enable the Surveyor to obtain the "variation." From the evidence before us we can easily learn that Mr. Smith was an honorable, upright gentleman, and a painstaking official, conscientiously devoted to duty, and universally esteemed and respected, and one whose services it must have been a misfortune for the country to have lost.

JOHN McAREE.

TORONTO, 18th February, 1889.

AZIMUTH BY MEANS OF TWO STARS.

In the proceedings of the Michigan Engineering Society for 1888, one of our valuable exchanges, there is given a method of determining a meridian, by observing two circumpolar stars, when both are in the same vertical plane, or on the same vertical, as usually expressed. The calculation of an example is given upon which an immense amount of figures is expended, 500 I should say, and there would be more, if "another approximation to give nearly the correct azimuth" was given. I find this calculation a little difficult to follow, and as I have for many years corrected my watch by means of a plumb line and two stars, and I think my method is more simple and direct, I shall try to give it. Most surveyors, I presume, get each year a copy of the Canadian Almanac, in which is given the mean time of the upper transit of Polaris for every day, this year it is in twenty-four hour time, though not in astronomic time, and why that astronomic event is not given in astronomic time is a question that I do not expect to hear satisfactorily answered in the near future. I am sorry to say this Almanac is not as reliable as t should be, there was an error of 1° in the declination of the Sun for nearly the entire of last December (1888), and that the perpetrator of it is not in durance vile argues a sad defect in the Criminal Code. If this sounds harsh to any one, I would ask him to consider what the consequences of such an error might be, possibly the loss of a season's work in the North West. But to return to the subject of this paper. A moment's consideration will show that if we find the hour angle of Polaris, when on the same vertical with another star (which is nearly a constant angle) and get from the Almanac the mean time of the transit of Polaris, we have the mean time of the coincidence of the stars on the same vertical.

As an example let us find what the hour angle and azimuth of Polaris is when on the same vertical with β Ursæ Minoris for a place in latitude 45° 36′ 0″ taking as data, the mean right ascension and mean polar distances of the stars for the present year.

To fix the ideas, we will suppose β Ursæ Minoris *Subpolo*, close to the meridian going East; Polaris about 1½ hours after upper transit going West.

Let there be a rough projection on the plane of the meridian showing the stars in such positions, upon which A, at the pole is the difference of the right ascensions of the stars, B, at the zenith, azimuth of Polaris, C the position of Polaris, C′ of β Ursæ Minoris, b the polar distance of Polaris, b′ of β Ursæ Minoris, h the hour angle of Polaris, c the polar distance of the place.

In the triangle whose angular points are marked by the two stars and the pole, there are given two sides and the contained angle, viz. A b and b′, to find the perpendicular AD (= p) from A on the third side, and the segments of the angle A. Draw an arc from A as A F bisecting A, let *n* be the greater segment of A, A—*n* the less, D A F = *n*—½ A B A D = (h + (A—*n*)).

The following are the formulæ for working :

$\text{Tan}\,(n - \tfrac{1}{2}\,\text{A}) = \text{Cot}\,\tfrac{1}{2}\,\text{A}\ \text{Sin}\,(\text{b}' - \text{b})\ \text{Cosec}\,(\text{b}' + \text{b})$ (1).

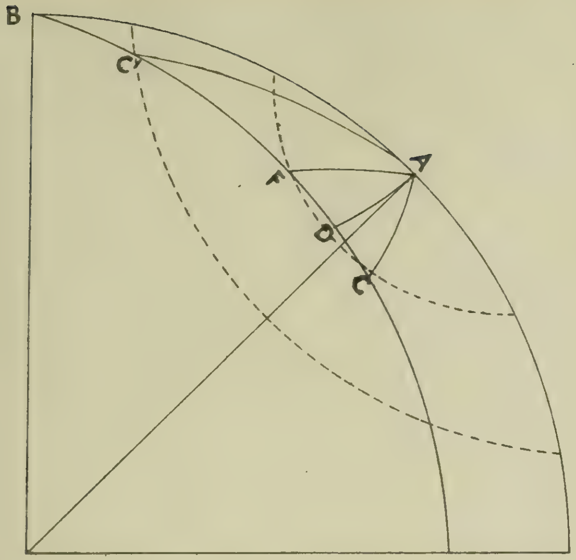
$\text{Tan p} = \text{Cos}\,(\text{A} - n)\ \text{Tan b}$ (2).

$\text{Sin B} = \text{Sin p Cosec C}$ (3).

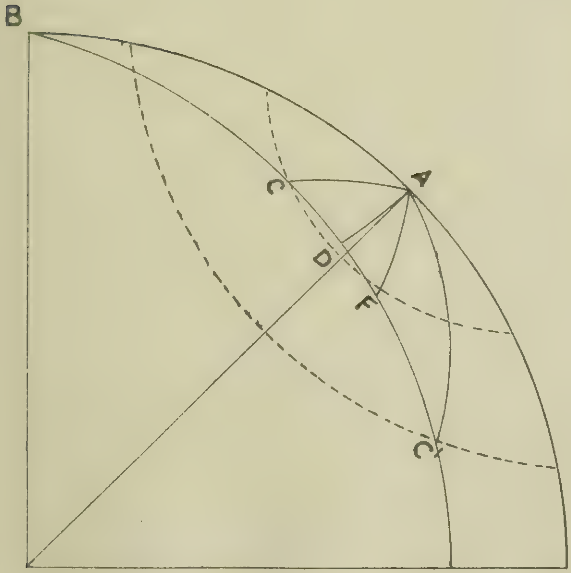
$\text{Cos}\,(\text{A} - n + h) = \dfrac{\text{tan p}}{\text{tan c}} = \text{Sin B Cos c}$ (4) (p being a very small arc).

For 1889.

	h. m. s.				
Polaris R A—24h	25 18 6	P D b	1° 17′ 0″		
Kocab	14 51 2	b′	15 23 18		
A	10 27 04	b′—b	14 06 18	Sin	938685
A in arc	156° 46′ 00″	b′+b	16 40 18	Cosec	054229
½ A	78 23 00			Cot	931297
n—½ A	9 54 20			Tan	924211
n	88 17 20				
A—*n*	68 28 40	Cos	9.5645		
		b Tan	8.3503		
		p Tan	7.9148		
		c Cosec	0.1551		
	40′ 23″	B Sin	8.0699		
		c Cos	9.8540		
	89°. 31′. 09″	(A—*n*+h) Cos	7.9239		
			h m s		
h	21. 02. 29	Mean Interval	1. 23. 51		
2 (A—*n*)—h	157. 59. 48	“ “	10. 30. 35		



Polaris below
β Ursæ Minoris above } *the Pole*



Polaris above
β Ursæ Minoris below } *the Pole*

S.L. Brabazon

Example—On the 1st of February, 1889, when had Polaris and β Ursæ Minoris the same azimuth, and what was it?

	Ast. Time h m s
(1) From Canadian Almanac, Transit of Polaris	4 28 46
h	1 23 57
Azimuth of stars = 360° 40′ 23″ or 359° 19′ 37″ at	5 52 43
(2) Transit of Polaris	4 28 46
(23° 56′ 04″—10 30 15) =	13 25 49
Azimuth of stars 40′ 23″ at	17 54 35

It must not be forgotten that the right ascensions and declinations of the stars vary, consequently B and h vary. For rigorous accuracy the calculation should be made with these quantities taken from the Ephemeris for the time of observation. Perhaps a little trouble might be saved by differentiating formula (1) thus—

$$\frac{d(n-\frac{1}{2}A)}{d\,\frac{1}{2}A} = -\frac{\text{Cos}^2\,(n-\frac{1}{2}\,A)\,\text{Sin}\,(b'-b)}{\text{Sin}^2\,\frac{1}{2}\,A\,\text{Sin}\,(b'+b)} = 0{\cdot}86 \text{ nearly.}$$

—d ½ A × ·86 gives a correction for $(n-\frac{1}{2}A)$, which if used with exact values of A and b in formulæ 2, 3 and 4 gives fair results. By this means for last year B was found 39′ 47″, h 1° 24′ 31.″

The entire calculation gives B 39′ 48″ and h 1° 24′ 33″.

S. L. BRABAZON.

PHOTOTOPOGRAPHY IN ITALY.

Transmitted by Capt. E. DEVILLE, Surveyor General, to whom it was communicated by the Italian Geographical Institute, through the Royal Italian Consulate for Canada.

(Translated from the Italian by Rev. F. Filiatre, O. M. I.)

INTRODUCTION.

Although experiments for the application of Photography to Surveying were commenced in Italy towards the middle of the present century, and although in 1875 our Institute tried Photography as an auxiliary to the plane table, it is only in 1878 that the Institute commenced more precise studies. Experimental Surveys were made by means of Photography or, more accurately speaking, Phototopography: they had for object the determination of the Topography of a given district by means of special Photographic perspectives of the district taken from different points of view.

To the present Director of the Military Geographical Institute, Major General Hannibal Ferrero, is due the initiative of those studies, as well as their important result. At the Institute Phototopography has been brought into practical use. In consequence of the direction and impulsion given to these studies by General Ferrero, the process has been used with advantage, not only for the survey of special districts, but is now employed jointly with ordinary methods for plotting the sheets of the new map of Italy comprising the highest and most difficult Alpine regions.

1. FIRST ESSAY OF PHOTOTOPOGRAPHY IN ITALY—DIFFICULTIES ENCOUNTERED.

Let us see the difficulties Phototopography had to go through in Italy. As early as 1885, Professor Porro turned his attention to the application of Phototopography to Geodeosy, ("Spherical Photography," as he called it) and he was the first to propose a Phototopographic apparatus intended exclusively for Topography, but he died just as he was fully engaged in developing the practical part of Rapid Surveying by Phototopography.

2. PORRO'S APPARATUS.

This apparatus consisted of a Camera Obscura with spherical focal plane, the center of the sphere corresponding to the optical center of the object glass. The latter was a hollow sphere filled with water, and provided with a proper diaphragm, precisely in the same manner as the object glass subsequently known as Sutton's.

We have a paper by Porro entitled "Application of Photography to Geodesy"; it is published in the Periodical "Il Politecnico" Volumes 10 and 11.

3. PHOTOTOPOGRAPHY AT THE MILITARY GEOGRAPHICAL INSTITUTE.

After the death of this prolific genius, no one appears to have taken up the new application of Photography until our Military Geographical Institute, being confronted by the difficult problem of the survey of the Alps for the new map of Italy, commenced to study the application of Photography to topographical surveys.

4. APPLICATION OF PHOTOGRAPHY TO PLANE TABLE SURVEYS.

First experiments in the Abruzzi-Gran Sasso.

The first trial was made in 1875 by Staff Lieutenant Michele Mausi, then engaged on the survey of the Gran Sasso in the Abruzzi. He used Photography as an auxiliary for drawing the survey on the plane table. The following year he was sent to the summit of Mt. Cenis where he made new experiments with a plane table and an ordinary photographic apparatus.

5. RELIEF OF THE GLACIER DU BART (MT. CENIS) SCALE $\frac{1}{10.000}$.

He brought back various panoramic views, taken by the wet process, by means of which he plotted the topography of Glacier du Bart, on the scale of $\frac{1}{10.000}$.

Numerous objections were urged against the new method: they were based on previous failures of this new application of Photography, due either to the employment of the wet process on high mountains or to the imperfect instruments of the time which did not furnish satisfactory images in the Camera Obscura.

6. BEGINNING OF SERIOUS STUDIES.

In accordance with the decision of a Commission, the phototopographic work of the Institute was suspended, not to be resumed until 1878. But General Ferrero, then Colonel and Chief of the Geodetic Branch of the Geographical Institute, could not fail to notice the wonderful improvements in photographic optics as well as in the processes for field photography, neither could he ignore the phototopographic work executed in other countries. In 1878 he again brought before the Directorate of the Institute the necessity of undertaking new studies of Phototopography. In pursuance to this proposal, Institute Engineer Paganini Pio was, during the summer of 1878, sent to the Apuane Alps with the following instructions:—

7. QUESTIONS PROPOSED AND CRITERIUM OF THE NEW STUDIES.

1. To find whether Photography was practicable on high mountains and whether on the difficult ground of the Alps such panoramic views could be obtained as would help the topographer in representing the true character of the ground.

2. To obtain extensive panoramic views which, properly reduced and reproduced by photogravure, could serve to improve the sheets of the new map of Italy containing the corresponding part of the ground.

3. To find whether such panoramic views could not themselves be employed for plotting the topography.

8. FIRST PHOTOTOPOGRAPHIC APPARATUS.

To answer these three questions, a new apparatus was constructed, consisting of an ordinary camera combined with a special instrument (Theodolite, Camera Obscura). In addition to extensive panoramic views free from distortion, the instrument furnished the data required for plotting, from the views, the corresponding survey.

9. FIRST EXPERIMENTS OF PHOTOTOPOGRAPHY—SURVEY OF THE MARBLE QUARRIES OF COLONNATA (CARRARA) IN THE APUANE ALPS. SCALE, $\frac{1}{25,000}$

During this first expedition 17 panoramic views, [110 perspectives] were obtained; they answered the purpose set forth in the above mentioned instructions. With some of them was plotted at Florence, on the scale of $\frac{1}{25,000}$ the topography of the Marble Quarries of Colonnata, Carrara, with contour lines at the equidistance of 5 metres.

10. MARITIME ALPS—SURVEY OF THE SERRA DELL' ARGENTERA—SCALE, $\frac{1}{25,000}$

The introduction of important modifications in the apparatus previously used, and the employment for the new gelatino bromide process, enabled Engineer Paganini, the following year, 1879, to represent the Serra del l'Argentera, the highest and most difficult part of the Maritime Alps, on a scale of $\frac{1}{25,000}$ with contour lines at the equidistance of 10 meters. The work was done by means of panoramic views taken during an expedition of two months and a half, from fifteen high stations and consisting of 113 perspectives. The plotting was executed at Florence the following winter and covered 73 square kilometers with 490 points located.

11. SURVEY IN THE GRAIE ALPS——SCALE $\frac{1}{50,000}$.

In 1880, the same Engineer commenced the survey, on the scale of $\frac{1}{50,000}$ of the part of the Graie Alps between the valleys of Orco, Valsoana, Cogue and Valsavaranche; comprising the highest group of the Alps within Italian Territory and with such high summits as the Gran Paradiso, the Grivola, the Gran San Pietro, etc. Engineer Paganini was engaged on the survey of this district, comprising about 1000 square kilometers, until 1885.

12. NEW PHOTOTOPOGRAPHIC APPARATUS AND DRAWING INSTRUMENTS FOR PLOTTING FROM PANORAMIC VIEWS.

In 1884, he used a new and improved Phototopographic apparatus constructed for the Geographical Institute at the Galileo works, on the designs of the above Engineer. He also devised three drawing instruments which simplify and render more expeditious the plotting of a topographical survey from panoramic views.

13. CONCLUSION DERIVED FEOM THE WORK EXECUTED AND RESULT-OBTAINED.

The last mentioned survey, although incomplete, fully demons strates that the phototopographic method can be employed with dvantage for the survey on the scale of $\frac{1}{25,000}$ or $\frac{1}{50,000}$ of the most important groups of the Alps. The technical problem was consequently solved if considered by itself.

14. NEW DIRECTION GIVEN TO PHOTOTOPOGRAPHIC WORK IN CONNECTION WITH THE REQUIREMENTS OF THE INSTITUTE.

The problem had also to be considered in connection with the requirements of the Geographical Institute and the compilation of the new map of Italy on the scale of $\frac{1}{100,000}$. The phototopographic surveys had to be employed jointly with the ordinary methods for the compilation of the sheets of the said map, phototopography being used as an auxiliary to the plane table in places where the employment of the latter is difficult. The financial side of the question had also its importance; it was necessary not to do by phototopography surveys already executed or which were being executed by the ordinary methods, because this would have been been a duplication of the work.

After suspending temporarily the work executed by the Engineer in the Graie Alps by the phototopographic method, work which had ceased to have an immediate object since the same district was being surveyed at the same time by several other parties, General Ferrero gave a new and, for the Institute, more important direction to the phototopographic work.

15. RETICHE ALPS—SURVEY OF SHEETS SIX AND SEVEN OF THE NEW MAP OF ITALY.

During the summer of the present year he gave a draughtsman to the Institute Engineer in charge of the above mentioned work and instructed the small party just formed to survey sheets six and seven of the new map.

The district to be surveyed covers about 450 square kilometers and comprises the valleys of San Giacomo and Lei, north of Chiavenna, (Province of Soudrio) as far as the Swiss Boundary, with the Splugen pass and the important groups of Tambohorna and Suretta on the north, Pizzo Emet and Pizzo Stello on the east, Pizzo Quadro and Pizzo Terre on the west.

The survey on this important region was subdivided as follows: the survey of the bottom of the San Giacomo Valley below the contour of 2000 meters and the easy and flat ground containing the houses, pastures, and alpine cottages, was given to topographer Rimbotti, who completed it with the plane table during the present season.

The remaining part of the ground from the contour of 2000 meters to the crest of the mountains, is being executed by the phototopographic method by Engineer Paganini, and will be completed next year.

It is already possible to foresee that the connection of the surveys executed by the two methods will be satisfactory and will present no difficulty.

IRRIGATION.

Mr President and Gentlemen,

Instead of the paper announced, I beg to submit a few notes on the subject of Irrigation as supplementary to the introduction contained in my paper last year.

The first thing I noticed in looking over the report of my last year's paper, was a mistake in the formula for finding the capacity of a ditch, where the sign of addition had been substituted for that of multiplication. By reading the former part, however, most of the readers would understand that the plus sign was an error and that the sign of multiplication should have been used.

In my present paper, which will be a mere outline, I will first advance a few notes on the construction of ditches and canals for conveying water. Then the methods of preparing and distributing the water over the surface

The lack of general information on the subject of irrigation may be illustrated by a conversation I had with a gentleman a short time ago, who was highly educated in some branches, but entirely without information on the subject of irrigation as practised in countries where the rain-fall is insufficient. We were discussing the capabilities of British Columbia as a field for agriculture, when I mentioned the fact that in the interior part of the country crops could only be raised by means of irrigation, and that, in his opinion, precluded all crops, except those which could be raised on a garden patch, and could be watered by hand, this being the only method of watering land which had come under his notice.

In a few words, I gave him the substance of the present paper, which put the matter in a different light.

The first consideration preliminary to irrigation is to have the water stored or delivered at a point higher than any part of the land to be watered, and how to accomplish this will depend on the physical features of the country, and the circumstances governing in every case. Where the lands are in a valley contiguous to hills or mountains from whence issue streams or springs which form the water supply, the problem presents itself in the most simple form, and nothing requires to be done except construct ditches to convey the water to the principal points where required. The size of each ditch will depend upon the area to be watered. Where the land requires full irrigation, there being no natural supply of rain to be depended upon, for each farm containing one hundred acres under crop there will be required as much water as will flow through a pipe twelve inches in diameter at a velocity of three miles an hour.

This we understand to be the quantity to be delivered at the farm, so that, at the origin of supply there will have to be added an additional quantity sufficient to make up for loss caused by evaporation and filtration, which when the water is brought a long distance in open ditches amounts to a large proportion. What the exact loss will be through these sources cannot be accurately ascertained, but the only means to do away with such loss would be to have water-tight canals closely covered and so avoid filtration, and prevent evaporation ; but as this usually means a large expenditure of capital, an expenditure often out of proportion to the good to be derived, it would be well to take into account the above mentioned sources of loss, so that a proper allowance can be made for them. The loss through filtration or percolation depends to a great extent on the soils, and for this reason in contemplating the construction of a ditch the selection must be made with a view to having the most compact subsoil, clay being the best, while sand and gravel form the worst. If where the subsoil is porous, a puddle of clay could be formed along the bottom of the ditch it would do a great deal to prevent the loss of water. Sometimes the bottom of a ditch can be much improved by driving a flock of sleep along it when it is wet or dragging logs through it or puddling and smoothing in different ways. In some ditches the loss on account of filtration where the water is brought a long distance amounts to as much as 50 per cent. Loss through evaporation is reduced to a minimum by making the canal as deep as practicable for the width. The narrower and deeper the ditch the less exposure of surface and consequently the less evaporation, It is scarcely needful for me to say that previous to the construction of an irrigation ditch it is necessary to take the difference of level between the source of water supply and locality where it is required to be delivered. I have however seen in my travels in British Columbia long ditches in some localities, where capital had been wasted in attempting to run the water from lower to higher ground by reversing the operations of the law of gravitation and which of course didn't work. The more intelligent farmers take the difference of level or rather ascertain where the water will run, and also obtain a constant grade by means of an implement which any one can construct for himself out of three pieces of wood put together so as to form a triangle which stands on two feet spreading any distance, but for convenience usually 16½ feet, this being a convenient unit of measure. This may be made into a level by attaching an ordinary level to the base of the triangle and adjusting in the ordinary way by turning the implement end for end.

A more practical method, and one which I have seen adopted, was to attach a string at the vertex of the triangle at the other end of which a plummet was fastened ; then this is prepared for use by marking the intersection of the plumbline with the base of the triangle then turning the implement end for end and marking again, then the middle point between the two marks will be the place where the plumbline will intersect when the two feet are on the same level. By taking the proportion of the height to the width, a scale of grades can be marked on the cross piece. To use the implement, a wooden plug is driven into the ground level with the surface to start from, at the beginning of the canal. One of the legs of the level is placed on the plug and the other forward in the direction in which the water is to flow and from side to side until a point is found level with the starting point or having the required descent. A plug is then driven into the ground at the second point and the operation repeated. We see that with this simple implement a person without any calculation may lay out a ditch with great accuracy at any required grade. To prevent washing away the banks and carrying out the bottom of the ditch it is important not to have a heavy grade. A fall of one foot in one thousand will give a velocity of about a mile and a half an hour, which is as great as would be practicable. The fall should be regular from beginning to end else the current will be more rapid when the fall is increased and will wash away the banks in the steeper parts and will deposit the detritus when the current slackens, which will soon spoil the canal or render repairs necessary. After the construction of the ditch the next important step is to have the surface properly prepared by furrowing or making water channels. The point to be remembered is that water always runs down hill. The surface to be watered should therefore have a slight slope as regular as possible in one direction. When the surface is ploughed this is done in such a manner as to have it as level as possible, and sometimes it may be necessary to use a scraper in taking off the tops of knolls and filling up the depressions. Where fields slope in several directions, the supply canals have to be constructed so as to convey the water to all the highest points. Sometimes the supply ditches run parallel to the main canal and at other times at right angles to it. The supply ditches are connected with the main ditches with gates at intervals of from five to ten chains so that the water may be let out at any point required. In British Columbia where I saw the process of irrigation the entire surface was covered with small water channels two or three inches deep made by dragging an implement like a wooden harrow with large teeth about eighteen inches apart up and down the slope forming striations over the entire surface. It intervals of four or five chains the supply canals would cross these, and when flowing full of water the water would distribute itself over the surface by overflowing the sides of the ditches into these little grooves and following these down until the next cross ditch is reached which supplies the land below it again. When the supply of water is limited only small portions of the surface can be watered at once, and it has to be turned in different directions so as to be allowed to flow over the surface just where required. Outlets are opened with a hoe in one place and closed in another, and constant attention by some one who understands the art of irrigation is needed to convey water to parts which may not be sufficiently saturated, and close the channels where the flow is excessive. The frequency with which the soil must be watered will depend upon the nature of the soil for retaining water. Evaporation from sandy soil is much more rapid than that from clayey soil, and a fine vegetable mold will retain the moisture longer than the clay, so that while sandy soil would require to be watered at least once a week, once in two weeks would be sufficient for a fine clayey loam. When once the water is delivered at the farm to be irrigated, the labor of irrigating a hundred acres or two to one who understands the method of arranging his supply ditches is not so great as one would naturally suppose.

In the above I have outlined the general method adopted in irrigating farms. It may be of interest to mention some methods which are adopted in different parts of the world for irrigating scientifically garden patches and other small patches of great value.

One method which has been in use for a number of years is that of sprinkling by means of hose with a perforated or flattened nozzle. The water is contained in an elevated reservoir from which pipes are laid underneath the surface of the ground and hydrants constructed at distances of say two hundred feet apart to which hose can be attached and the surface watered by one man at the rate of four or five acres a day.

A modification of this plan has been adopted in England for watering meadows where the pipes are perforated and laid on the surface at distances of some thirty feet apart, the water flows out of the perforations in different directions covering the surface of the ground, and requires no attendance except to turn the water on and off and to change the direction as required.

Another system sometimes adopted is that by means of perforated tiles, which are laid underneath the surface to a depth at which the plough share will not interfere with them and at distances of not more than eight or ten feet apart. The water escapes from the tiles and rises by capillary attraction or absorption to the surface of the soil. Of course this method cannot be adopted where the water supply is in any way limited as a great deal of the water will sink into the ground and be lost.

There is one consideration in favor of underground irrigation, the land does not leak but keeps moist and loose, and on that account requires a much less quantity of water.

One point to be remembered, and which might be overlooked by the inexperienced, where there is a copious supply of water is the possibility of overdoing the thing. Too much irrigation is worse than too little, and frequent light irrigation on the surface has a tendency to harden the soil and the water does not reach the roots where most required.

From this view we might infer that a thorough watering one in ten days would be by far preferable to frequent light surface sprinklings.

Some crops require more water than others, and those who would practise the art successfully, must familiarise themselves with the characteristies of each in this respect.

This question of irrigation is one which must soon become of vital importance and interest in Canada

I was pleased to see from the programme that we are to have in our report a paper on settlement and irrigation as applied to the Northwest, by a gentleman who on account of his extensive knowledge of the country and facilities for becoming acquainted with these problems will enable him to speak with authority.

Having brought the subject forward once more, believing it to be important as a question for consideration in Canada, I submit these few notes without further comment.

THOS. FAWCETT.

SUGGESTIONS FOR SURVEYORS' REPORTS.

For many years to come, as population in Canada spreads beyond its present limits, surveys of the newer and little known parts of the country will continue to be made. Whatever will add to the public value of the reports upon such surveys will necessarily be of interest to the members of the Association, and the object of my present communication is to suggest, from the standpoint of an outsider, some particulars in which these reports can be rendered even more useful than they now are.

I quite agree with those who in the discussion on Prof. Macoun's paper at the last annual meeting contended that a surveyor had, in such surveys, a particular limit of duties defined for him, and that the search for, and collection of Natural History specimens, involved special work, requiring a love for science to make it successful. It is not everyone who has scientific tastes, and the necessary knowledge which the preparation of, more especially, Zoological specimens implies.

Many surveyors will also, probably, consider that they already have sufficient work in the field of a mechanical nature. Every member of the profession must, however, desire to have his reports not only valuable to the Department of the Interior, or of Crown Lands, but useful to the general public, when they appear in the official documents of the Government. If this usefulness can be increased without materially adding to the labor involved, then an important advance has been made.

When surveying a new township, there are the best of opportunities for observing, without effort, its natural features. In the course of his ordinary duties the surveyor not merely meets with level country, but has to ascend the hills which lie in his way, cross the valleys which intervene between the heights of land, and track the courses of streams. He is thus led, by observation, and without going out of his way, to acquire a fair knowledge of the character of the soil, the kind of trees met with, the nature of the prevailing rock where exposed, the breadth of prairie available for cultivation, the extent of the marsh-land, the appearance of the grasses, and, generally, the suitability of the township for settlement.

The report made to the Government generally covers some, perhaps in not a few cases all, of these points, and are, thus far, very valuable to intending settlers.

Might I, however, suggest that they should be somewhat more detailed in order that the information may be useful also to the lumberer, the miner and those interested in science.

I have had occasion when studying the distribution of forest trees, to frequently consult the Crown Land reports, and have found it sometimes difficult to make them available because of the lack of definiteness in naming the trees. The beech and basswood are samples of trees not easily mistaken, as, in this country, there is only one species in each case. It is different, however, with the pine, spruce, ash, oak, maple, and other trees, where two or more species occur. To the lumberman and to those interested in forestry, it is essential to know what definite species is intended in each case. The white pine, *Pinus strobus*, is more valuable than the red pine, *P. resinosa*, and the Banksian or Scrub pine, *P. Banksiana*, is inferior to both. Oaks, both the White Oak, *Quercus alba*, and the red, *Q. rubra*, are commonly met with in the older provinces, and the former is the more important. The White Ash, *Fraxinus Americana*, is more useful in the arts than the Green Ash, *F. viridis*, or the Black Ash, *F. sambucifolia*, whilst among the Maples, *Acer, saccharinum*, is more valuable to the settler than the red Maple, *A. rubrum.* I would not propose that surveyors should become botanists, but that they should always indicate with sufficient accuracy both the occurrence and the abundance or not, of the important forest trees they meet with in each township.

In particularizing them it would be well to avoid the use of local names with which the general public would not be familiar and to. if possible, add the scientific after the commonly accepted name, Thus, when referring to a specimen of Pine, let it named, as the case my be, "White Pine, *Pinus strobus*" or "Banksian or Scrub pine, *P. banksiana*," a little practice would soon make these specific names sufficiently familiar to prevent any misconception as to the particular tree intended. That the character of the soil can to some extent be guaged by the trees upon it, is an additional reason for indicating the species with accuracy.

On the Western Prairies if the survey is made during a dry season of the year, it is possible to ascertain whether the land is marshy or overflowed during wet seasons by the occurrence of certain common species of grasses which frequent moist localities and which some observation soon enables anyone detect. It is in this way sometimes possible to avoid the mistakes which occasionally appeared in the original surveys in Manitoba in describing as dry, open country what, during wet seasons since, has been overflowed by water.

The surveyor unfortunately meets with, too frequently, immense stretches of country laid waste by fire and all its valuable timber totally destroyed. It is estimated that in Canada very much more timber has thus been burned than has, during the whole progress of lumbering in the past, been cut for the market and for home consumption. I have also always been of opinion that our Northwest prairies would now be largely covered with timber, and that the climate in consequence would be milder in winter, were it not for the vast prairie fires which annually sweep through whole townships at a time destroying, not merely all the grass, but all bluffs of young trees which appear in their path.

The origin of these fires is usually credited to hunters, Indians, pioneer settlers and parties of travellers who carelessly leave behind them camp fires still burning to which the dry grass and leaves surrounding furnish fuel on the slightest breeze. It is difficult, however, to fasten the blame on any particular shoulders, so distant, usually are the localities from the settled districts. The facts still remain that disastrous fires every season take place and vast damage is done, amounting annually to millions of dollars. Now, I think that surveyors and engineers can be of service in this matter not only in impressing upon the members of their parties the necessity of great care in putting out camp fires, but inducing others whom they meet in the bush and on the prairies to do the same. There is some patriotism involved in even an apparently insignificant matter like this.

Another suggestion and I have done. It would be idle to expect a knowledge of geology from everyone, but if the reports of surveyors upon the new or little know parts of the country would refer in general terms to the character and extent of the rocks where they crop out from beneath the soil, if would be useful both from an agricultural and from a scientific point of view. If the information went no further than alluding to the rock or sandstone, or lime, or granite, the mode in which it occurred and the extent to which it effected the agricultural capabilities of the township or section of country surveyed, the information would be valuable ; how much more so, if it referred to the economic importance, if any, of the rock as furnishing building stone, phosphates, iron, copper, or other economic minerals.

The surveyor necessarily visits most parts of the township which he is mapping into sections or concessions and lots. The geologist often has to restrict himself to the larger rivers.

The general information which the surveyor gleams in following his avocations in the newer parts of the country, can thus be of considerable use to the geologist, and eventually to the miner; just as a rough preliminary survey along the route of a proposed railway gives hints to the railway engineer.

A. T. DRUMMOND.

SETTLEMENT AND IRRIGATION

OF THAT PORTION OF THE NORTHWEST TERRITORIES WEST OF THE EASTE N LIMIT OF THE MISSOURI COTEAU, AND SOUTH OF TP. THIRTY.

"Whoever makes two blades of grass grow where but one grew before is a benefactor to his race."

We hear of irrigation at a very early period of the world's history and in different quarters of the globe. The Egyptians adopted it extensively in the cultivation of grain, and Babylon and Nineveh had irrigation works on a scale, which even to-day, in this age of gigantic undertakings, would seem marvelous. Among the first inhabitants of the American Continent who were at all advanced in the arts and sciences, irrigation was employed to render fruitful land, that, unless supplied with moisture, must have remained barren for ever. Even the ignorant and uncivilized Indians of the South-western States and Territories of our neighbors to the South produce by this means what grains, fruits, &c., they are able to grow. It is said that were it not for irrigation, the garden and field products in the Territory of Montana would not equal two-thirds of the quantity raised now by the artificial distribution of water, and it may be said of Idaho, Utah, Colorado, New Mexico, Arizona, Indian Territory, Western Texas, and the southerly half of California, that in the absence of irrigation, not more that 10 per cent. of the present yield could possibly be obtained; and according to the reports of United States Engineers, a very large percentage of the territory west of the 100° longitude is useless without irrigation.

The settlers who have made their homes in the portion of our North-West, to which I now particularly refer, have, as a general thing, come from the eastern provinces of Canada and from Great Britain, countries in which the rain-fall and water supply are so abundant and so widely distributed that irrigation is unknown. Had our settlers come in any material number from irrigated districts, bringing with them for application here their knowledge and experience of the practices in vogue in Montana, Arizona, or any districts requiring an artificial water supply, it is probable that the number of our settlers would be greater than at present, and their advancement in production and wealth would be enormously increased.

The lands which they now occupy formed, at a very recent date, a part of what was erroneously described upon the maps of this continent as "the great American Desert," a term that certainly does not apply to any part of our territory west of the Missouri Coteau. While, however, this is the case, it is equally certain that the district in question is not favored with a sufficient rainfall, and that although the soil is of fair quality, it cannot be made productive, unless means are adopted superior to any now in use; it is, to my mind. of the utmost importance that some comprehensive system of settlement and irrigation should be originated, adopted, and made effective without delay. I am convinced that unless this is done, the progress of settlement will be slow, and the country necessarily so sparsely settled, that our people will not, for a very long time to come, enjoy the privileges of schools, churches and social intercourse, which are so essential to the well-being of all communities, and which might be made available to them if the right plan were designed. The present system of settlement is admirably suited to localities, where water can be obtained upon every quarter section, at an outlay commensurate with the means of the average settler. The danger however of pursuing this course, in the part of the Northwest which we are now considering, is that the earlier settlers will unquestionably occupy the lands bordering the streams, lakes, and rivers, representing, perhaps, not more than 15 % of the whole area that might be settled if water could be generally distributed.

Whatever is done in this matter should be done quickly. If irrigation is to be adopted, a reservation should be made immediately of right in the Crown, to enter upon lands entered for as homesteads or pre-emptions, or sold, for the purpose of constructing irrigating works across, over, or upon such lands. The settlement now taking place will probably, unless checked, control in a short time nearly all of the water that should be utilized to its fullest capacity, in rendering useful for tillage the 85 per cent of the whole area which is not suitable for occupation at present, in consequence of the very inadequate water supply.

These remarks apply with equal force to a large extent of country in the central parts of British Columbia. Several members of our Association, who have been engaged in surveys there, have in their reports directed attention to the condition of affairs referred to.

If my premises are correct, I repeat that no time should be lost in endeavoring to devise and carry out a scheme, that will enable this district to be utilized to the fullest possible extent; and it may be shown very clearly, I think, that if the means adopted were to prove successful, the result to the Dominion at large would more then compensate for any possible outlay of the public funds in the works which might prove necessary.

It is apparent to anyone familiar with this district that apart from its mineral wealth, its resources are and must continue to be chiefly pastoral rather than agricultural, the raising of horned cattle and horses, sheep, hogs, poultry, and the manufacture of dairy products will probably be for all time the staple industries.

After very careful examination into the present condition of things, it has been estimated that 20 acres of land are required to support every cow or horse, or every five sheep. Now, as a settler cannot make a fair livelihood unless he has from 100 to 185 head of cattle, he requires from 2000 to 25,000 acres for his exclusive use, or, say, four sections. The plan adopted by the Department of the Interior, of leasing free from competition four sections to any *bona fide* settler, was probably based on the foregoing calculation.

The capacity of any country for stock may be gauged by the quality and extent of the pasturage available in winter. At all other seasons, the district which we are now discussing yields at least four times the quantity of grass that could be consumed by the number of cattle, which it would be safe or advisable to run during the winter months.

The area of this district is 66,960 square miles, and would, according to the above computation, allowing 4 sections for every settler, accommodate 16,740 families; and estimating that each is worth to the country $1000, owing to the custom and excise duties which he pays, the whole value would be $16,740,000. The value of the annual products of each settler may be estimated at $500, giving a total value of $8,370,000, and supposing that each settler has 100 head of cattle, 1,674,000 will graze in the district.

This condition of affairs, which unless special means are adopted we cannot, under the most favorable circumstances, hope to arrive at for some time to come, implies an exceedingly sparse population.

Suppose, however, that the productive power of the district could be quadrupled (and I hope to assure you that this may be regarded as a moderate estimate of the result to be achieved, by adopting a proper system), the number of resident families would be 66,960, the annual products $33,480,000, the value of these settlers to the country $66,960,000, and the number of cattle 6,696,000, the value of which, at $20 per head, would be $133,920,000. The value of the annual products would probably exceed largely $500 per head, as under the system which I have in view, their products would be more valuable than at present. We would most certainly arrive at the highest state of perfection in all products, cattle and horses, hogs, poultry, dairy products, hides and leather, nature having richly endowed this district with the natural conditions requisite to this end.

It is generally conceded, that in order to minimize the risk of loss in cattle raising, it is necessary to provide for six weeks' winter feeding, spread over three months, and that by this means the country could be stocked to the limit of the summer capacity. Many stockmen assert that this provision is unduly large; that the only cattle requiring attention during any part of the winter are the fall calves and colts, and cows and mares expected to bring forth calves or colts in the early spring, together with the injured or weak stock. It is therefore safe to assume that six weeks' fodder for the whole herd would be adequate provision.

Should we not endeavor to bring about such a condition of affairs, that for ten and a half months of the year the country may support a number of cattle equal to its full summer capacity, as well as providing the fodder required for the six weeks of winter ? Under present conditions we can accomplish not more than a quarter of that result—in other words, during one-eighth of the year only do we make use of its full capacity. Even should it require a very strenuous effort to remedy the existing state of affairs, does not the probable result amply justify it ?

It occurs to me that the remedy can be found in adopting the hamlet system of settlement, coupled with irrigation. To this end, it is necessary, in the first place, that there should be a thorough inspection of the country, and then we should require an intelligent survey to ascertain levels. In this connection, I am of the opinion that a thorough trigonometrical survey, combined with a full showing of details of levels, designated by contour lines, would be of incalculable benefit; we should, at the same time, record full meteorological observations, gauge the flow of all streams and springs during every month of the year, and we should also make thorough tests for artesian wells.

Once this data obtained, an adequate scheme of irrigation could be readily elaborated. The hamlets would necessarily have to be located at those points from which water may be most easily distributed, the area irriguous at the several points, to determine the number of families to be settled at each ; they would probably vary in number from 10 to 50, and in some cases might exceed the latter figure. The irrigated lands would be devoted to the growth of cereals, grasses, &c., and fodder required during the severe winter weather.

Each hamlet having a plentiful supply of water would develop into a dairying centre, where, at the minimum of cost, by the establishment of factories, and creameries, cheese and butter of the highest quality would be produced. The hamlets would also possess the social conditions necessary to the community, and all that are attainable in any well-settled agricultural region. Surrounding these settlements, the land required for pasturage by each would be set apart, defined, and reserved for that special purpose.

The more the writer has studied this subject, the greater the importance has seemed of the results aimed at, and the more easy their accomplishment. One season would be sufficient to obtain the data necessary to initiate the scheme, and it could thereafter be rapidly carried out as the progress of settlement might demand.

Upon the boundaries of the land allotted to each hamlet, firebreaks could be maintained, thus protecting the grass, and remedying the incalculable permanent injury to the productive power of the soil caused now by repeated burnings. This is a point to which public attention has not been directed as forcibly as it should be. Upon gravel ridges, and ridges of light soil, autumn fires destroy a large proportion of the grass roots, and the ground being left bare, every particle of snow that falls upon it is blown away; no moisture is retained, and by the time the spring and summer rains commence, usually after the 20th May, more of the grass is killed by hot suns and parching winds. Each year vegetation is becoming less, and if the process be but continued long enough, the lands referred to, which form a large proportion of the whole area of the district, will become practically valueless. In this particular alone, incalculable benefit would result from the adoption of the proposed system. If fires were prevented, and the sod torn by heavy harrows, the rain would moisten the grass roots, and the result would be a marvelous increase in vegetation. It has been observed that where rain upon cultivated land penetrated to a depth of ten inches, it does not penetrate one inch into these matted grass roots, but simply runs off the ridges into ponds and other natural basins. This agrees with the experience of every one who is accustomed to a prairie country dotted with sloughs, ponds, &c. The ridges being once cultivated, the area of these sloughs and ponds decreases, until finally they in many cases disappear altogether.

Nature seems to have fitted a large portion of the country for economical irrigation. There are strong inducements for the investment of private capital in extensive irrigation works, the profit resulting from the enhanced value of the lands. As a rule, irrigated lands are four times as valuable as lands in the same neighborhood entirely dependent upon the natural rain-fall. In the former case the tiller of the soil has complete control; he may put on water at the right time and in proper quantity, which means simply that other conditions climatic, for instance, being propitious, a good yield is, with him, a certainty, whilst the tiller of land that is not irrigated is subject to the worst effects of the most serious evil from which the district suffers—drought.

In the Southern States, many "ditch companies" are now operating very profitably, supplying water to the settlers for irrigation purposes at specified rates. Innumerable advantageous openings for similar enterprises must in a short time present themselves here. In this connection it might be well that Parliament should be asked to enact the necessary legislation controlling the waters of rivers and streams for the public use and benefit, and restraining individuals from monopolizing more than they can themselves profitably use. It is obvious that the sooner this is attended to the better and easier it will be, and will prevent friction and annoyance that will certainly increase the more the longer we delay. There is nothing extremely radical in this proposal; the same principle has been the law of the land in respect to mining properties for many years. It long ago became apparent that to confer exclusive rights of ownership upon individuals, who thereby prevented others from gaining access to and using the water that was of no actual benefit to themselves, and was nevertheless an absolute necessity to the miner who did not occupy some part of the water front, was working serious injury to the mining interests. Public opinion ultimately compelled a change in the law that is found to work most satisactorily.

The necessity of legislation in regard to the freedom of access to waters, running through or being upon agricultural lands, is fully as urgent as it was in respect of mining lands; the profits from the former must ultimately far exceed the profit to be derived from mining lands; in the one case we keep adding to the value of our lands, and in the other their value is constantly diminishing through exhaustion of the minerals, the surface property being generally of small utility for any purpose.

It is worthy of the most serious consideration whether any large scheme of settlement and irrigation should not be conducted by the Government rather than through private enterprise. The enhanced value of the lands would amply recoup the Government for the outlay. What an enormous benefit would result to the country if settlement and products could be increased, even to one half the extent which I suggest as probable, and certainly Government control is preferable looking to the general advantage. Private investors would be most anxious to secure large profits and quick returns, and would probably be somewhat dilatory in taking action, whilst endeavoring to demonstrate to investors and possible shareholders, the advantages which the speculation offered. The Government on the other hand, once convinced of the soundness of the scheme, the advantage to result indirectly from the improved settlement and producing power of the district, might feel justified in proceeding immediately, and in awaiting a slow return of the actual money invested. I dare say a calculation might readily be made, to show that a handsome percentage on the capital invested would very speedily result from increased customs and excise returns.

In the district mentioned there are two great sources of water supply, which lie high enough to permit of the whole volume of water being utilized for irrigation at a minimum cost of works. I refer to the Rocky Mountains and to the great Cypress Hills Plateau.

For hay lands the water can with advantage be laid on during autumn, winter and early spring, when cereals do not require its application. When it is necessary to apply it to the cultivated fields, the grass has so grown and so shaded the ground, then thoroughly saturated, that no more moisture is needed for the full fruition of the hay crop. The season when cereals require most water is when mountain streams are at the flood.

Many districts in the Southwestern States, after being comparitively well settled, have been almost deserted, owing to drought. Everyone who had the means to enable him to remove to another and more favored locality did so; those who were, through poverty, unable to seek a better place, managed in time to overcome the difficulties of their position by irrigation, and were no doubt eventually better satisfied with their lands and prospects than if they had gone elsewhere. Works accomplished under such conditions, done piecemeal, with lack of money, often with a not very intelligent understanding of the requirements of the situation, must necessarily prove more arduous, more tedious, and, indeed, in the end more expensive and less effective, than works undertaken with a full knowledge of present and future requirements, where each section as completed fits in harmoniously with every other section, and in due course forms a perfect system. If, therefore, works done by individual effort and under the difficulties which I have mentioned prove profitable and of public benefit, how much more profitable and beneficial are they likely to be if conducted under intelligent and competent direction and on a comprehensive basis. Under such a system of irrigation, the destructive effects resulting from freshets in mountain streams, which now do very considerable damage, would be materially lessened and if the fullest precautions were taken would be avoided *in toto.* The saving effected in bridges, in the protection of "bottom" lands, detentions, and general inconveniences to the public would go a long way to meet the outlay on works. I may say further that benefit would, in no small degree, be conferred upon settlers in the country lying to the east of the irrigated track, whose lands would be affected by the distribution of the waters. It has gravely been suggested to the Government of the United States, by gentlemen of high professional standing, than whom no one on this continent is more competent to express an opinion in matters of this sort, that it would be a wise and economical project on the part of that Government, if five hundred of millions of dollars were devoted to damming the streams flowing east from the Rocky Mountains, thus preventing freshets maintaining the streams at as nearly as possible a uniform level, and also adding to the extent of navigable water, and producing some effect in the prevention of summer drought. Does it not seem that a scheme somewhat upon the lines of the above suggestion might very probably and profitably be attempted in our own country?

My object in presenting this paper has been simply to direct attention to the general subject, leaving to the future, and I trust the early future, its further and complete elaboration. If it appears to this Association to be one-tenth part the importance which I attach to it in the general interests of our common country, I may then look or hearty sympathy and for most valuable co-operation in the effort to utilize the valuable resources now dormant, with which Nature has endowed this western portion of Canada.

To the President, Vice-President and Members of the Association of Dominion Lands Surveyors, Ottawa, this paper is respectfully submitted by

WM. PEARCE.

Calgary, Alberta, January 10th, 1889.

DOMINION GOVERNMENT SURVEYS IN MANITOBA, THE NORTHWEST TERRITORIES AND BRITISH COLUMBIA.

On the 22nd of June, 1869, His Excellency the Governor-General gave his assent to one of the most important Bills ever passed by the Parliament of Canada. This Bill was one providing for a Territorial Government for the Northwest Territory, arrangements for the purchase of which from the Hudson's Bay Company had been concluded.

The acquisition of this vast territory, known at that time as Rupert's Land, threw upon the Government the duty of promoting the early settlement of the country by the encouragement of immigration. To this end it was necessary that a comprehensive scheme or system of surveys, based upon the most accurate systems extant, should be initiated and developed.

To the Department of Public Works was delegated the important duty of initiating the system, and conducting the surveying operations.

On the 10th of July, 1869, instructions were issued by the Minister of Public Works to Lt.-Col. J. S. Dennis, P. L. S., directing him to proceed to the Red River settlement, for the purpose of selecting the most suitable localities for the survey of townships required for immediate settlement. He was also instructed to submit a scheme or system, to be followed in surveying the newly acquired territory, and to assist him in preparing this system, he was accredited to the Crown Lands Departments, in Canada and the United States, with the view of his obtaining all information and advice which were likely to be of use to him in preparing his system.

On his arrival in the Red River country, Col. Dennis proceeded to examine the districts requiring immediate survey, and giving due weight to the views of those with whom he had consulted on the subject, he formulated a scheme or system to be followed in surveying the country into townships and sections.

The system proposed was as follows:

(1) "The system to be rectangular, all townships and sections to "be east and west, or north and south.

(2) "The townships to number northerly from the 49th Parallel, "and the ranges of townships to number east and west from a given "meridian. This meridian to be drawn from the 49th Parallel, at a "point say 10 miles west of Pembina, and to be called the Winnipeg "Meridian.

(3) " The townships to consist of 64 squares of 800 acres each, " and to contain in addition 40 acres or 5% in area in each section " as an allowance for public highways.

(4) " The townships on the Red and Assiniboine Rivers, where " the same had ranges of farm lots laid out by the Hudson's Bay " Company, to be surveyed, the broken sections butting against the " rear limits of such ranges, so as to leave the same intact as independent grants."

This proposed system was referred to the Minister of Public Works for confirmation, and on his recommendation was adopted and authorized by an Order-in-Council, dated the 22nd of September, 1869, and thus the survey into townships of newly acquired territory was begun.

The system adopted was founded on that in force in the adjoining Territories of the United States, but it differed from the American system, mainly in regard to the size of the townships, and in the percentage allowance for roads, there being no allowance for this purpose in the American system.

The surveys were begun late in the summer of 1869, two surveyors (Messrs. Webb and Hart) being engaged in carrying on the work, under Col. Dennis. The work performed consisted of the survey of the Winnipeg or Principal Meridian, and also of portions of the Bases according to the system adopted. There was also considerable work done in connection with the re-establishment of the lines bounding lots, surveyed by the Hudson's Bay Company along the Red and Assiniboine Rivers.

During the fall the work in the field was retarded, and finally stopped by the out-break which occurred in the Red River settlement.

In May, 1870,a portion of the territory was created a province under the name of Manitoba ; but owing to the unsettled state of the country, nothing in the way of surveying was done during this year, because the question of surveys in the country received considerable attention, and in the early part of 1871 the management and control of the surveys and lands was transferred to the Department of the Secretary of State, and in March, 1871, Col. Dennis was appointed Surveyor-General of Dominion Lands. A very important change was now effected in the system of surveys ; the townships were reduced in size from 64 sections of 800 acres each, with road allowances as already mentioned, to townships of 36 sections, containing 640 acres each, and a fixed road allowance of 1.50 chains in width was provided on all sides of the sections.

This change in the system was provided for by an Order-in-Council, dated the 25th of April, 1871.

On the 1st of May, 1871, the Surveyor-General issued a Manual of Instructions, for the guidance of Deputy Surveyors,—as they were then styled,—engaged in the survey of Dominion Lands.

This Manual of Instructions, which was issued under the authority of the Secretary of State, and based upon the Order-in-Council above mentioned, set forth in detail the method to be followed in laying out and subdividing the townships in the field, as well as all other information to enable a surveyor to carry on his work satisfactorily.

This Manual may be said to form the basis or starting point for our survey system. I will therefore refer briefly to its main features.

(1) The public lands in Manitoba and the Northwest Territories were to be laid out in townships containing thirty-six sections of one mile square, together with road allowances between all townships and sections of one chain and fifty links in width.

(2) The townships were to measure on each side from centre to centre of road allowance bounding the same, 489 chains, this measurement on east and west boundaries being subject to excess or deficiency resulting from convergence of meridians.

(3) The townships to number northerly from the 49th parallel of latitude or International Boundary, and were to be numbered in ranges east and west from the Winnipeg or Principal Meridian, which had been established as mentioned in the first scheme submitted.

(4) The 49th Parallel or International Boundary to be the 1st Base Line, and the line between every fourth tier of townships to be a base line. The intermediate line, midway between the bases, being called a correction line, upon which the convergence of meridians is provided for by a jog between the meridians semi-north and south from the bases.

The first process in surveying any desired tract of country was to project blocks of four townships by running the base, meridian exteriors, and correction line bounding the same.

In surveying these lines the surveyors made all sections 80 chains in width, and provided a road allowance of 1.50 chains between all sections; on the meridian exteriors all sections were made 80 chains in length, excepting those adjoining the correction line, in which the excess or deficiency in the length between the bases was provided for. On these lines also a road allowance of 150 chains was left between all sections.

In establishing the correction line to complete the survey of his block, the surveyor ran the north or south side of the road allowance, the north side if the block being surveyed lay to the north of the correction line, and the south side if the block lay to the south. In defining the correction line, the necessary jog was allowed at the intermediate township corner to provide for convergence of meridians, and the sections were so marked as to throw the excess resulting from the same cause into the tiers of quarter-sections adjoining the western boundary of the township.

The block of four townships was now ready for the subdivision surveyor, who proceeded to effect the subdivision : First quartering the block into townships by connecting the township corners, already established on the block outlines, by straight lines, he then subdivided the townships into sections and quarter-sections, by running each interior meridian parallel to the eastern boundaryof the township, and making all sections 80 chains in length and width except those adjoining the western boundary, or adjoining the correction line, which were effected by the convergence, or excess or deficiency in length between bases, as has already been explained.

In all cases except the correction line, the lines surveyed were the south and west limits of the road allowance, and these lines only were marked.

The largest portion of the country to be surveyed being open prairie, and the conditions being so different to those to be met with in marking surveys in the old Provinces, an entirely new system of perpetuating the surveys had to be devised.

The difficulty was met by providing for placing posts only in wooded districts, and by marking the corners with posts and mounds in the open country. These mounds were constructed of earth pyramidal in shape, the bases being 5 feet and the mound 2½ feet high, the mound was surrounded by a trench, and there were also pits placed opposite and a short distance from the bases.

The posts placed at section corners were marked in a very simple and legible manner, and a further provision was made for perpetuating the township corners, by placing iron bars 1¼ inches square and 5 feet long, marked with a cold chisel, and finally driven into the ground at these points.

The mounds placed at township corners were also somewhat larger and better than those placed at section or quarter-section corners.

It is of course impossible to give within the limits of a paper of this kind, a full explanation of the system of survey, nor is this necessary, in view of the fact that the large majority of our members are thoroughly conversant with the system. I will therefore proceed to refer briefly to the amendments to this manual, which have since come into force, and to some other changes which have been made in the details of the management of the surveys.

One of the first important changes made was in the title of the surveyors engaged in surveying the Dominion Lands. These surveyors had first been styled Deputy Surveyors, but in the year 1872 when the Board of Examiners was constituted, the title was changed to Dominion Land Surveyors; and later on a further provision was made for the granting of higher certificates to surveyors styled Dominion Topographical Surveyors.

The first Manual of Survey and second System remained in force until the year 1880, at which date a change was made in the manner of running the block lines, the correction lines being run as base lines, and in subdividing townships the interior north and south lines were run as true meridians, and not as lines parallel to the east boundary, in manner provided by the Manual of Surveys.

The size of the blocks first laid out was increased from four to sixteen townships. However the district affected and the work done under these amendments was comparatively speaking very limited, and it was not until the 17th March, 1881, that any marked change was made in the system.

At this date a new edition of the Manual of Surveys was issued by Mr. Lindsay Russell, the then Surveyor-General, and some important changes in the system were made, in fact what is properly the Third System came into force. The main features of change were as follows: the method of laying out blocks of 16 instead of 4 townships, as the first operation of surveying, any given tract of country which had been in force during the previous year was given effect, the provision of the first manual regarding road allowances was altered, so as to provide roads of one chain instead of one and a half chains, and the road allowances on the first, third and fifth interior east and west section lines were abolished.

Provision was made for the equal distribution among all the sections of the error resulting from convergence of the meridians, and a slight change was made in the mounds placed to mark the corners of townships, sections, and quarter-sections.

This second manual, or third system, remained in force until the 1st of June, 1883, when a third and further amended edition was issued, this being the manual and system now in force, the system being the fourth authorized.

This last-mentioned manual differs only in some minor details from that issued in 1881. The important points of difference being in regard to the marking of corners with iron posts and tins in prairie districts, instead of with a wooden post.

Provision was also made for the survey into river lots of the lands adjoining the Saskatchewan and Bow and Belly Rivers, this provision has however since been done away with.

The foregoing is a brief mention of the manner in which the surveys in Manitoba and the Northwest Territories were initiated, and of the systems which have been in force since the inception of the surveys, together with a short synopsis of the provisions of the manuals of survey, which have from time to time been issued for the guidance of those engaged in carrying on surveys for the Government. I have also noted the changes which have taken place in the system, and the manner in which it has been perfected, until we now have a system which, for simplicity, accuracy, and general public utility, will compare favorably with any in the world.

It may be of interest now to note the amount of work which has been completed, under the different systems from the inception of the surveys in 1869 to date.

SYSTEM.	NUMBER OF TOWNSHIPS SUBDIVIDED.	MILES OF OUTLINES SURVEYED.	REMARKS.
1st		100. 00	(Approximate.)
2nd	870	619. 00	
3rd	141	150. 00	
4th	2,101	11228. 00	
	3,102	12097. 00	

These figures give an average of 173 townships subdivided, and about 670 miles of outlines run each year, and when it is considered that these figures do not include the large amount of work performed in surveying the river belt parishes in Manitoba, the survey of river lots in 179 townships along the Saskatchewan, Bow and Belly Rivers, and the extensive exploratory surveys referred to further on in this paper, the showing is certainly a most creditable one, and one which has not been excelled, if equalled, by any other country.

I will now refer shortly to the surveys which have been performed other than those which come properly within the scope of the systems, as provided by the Manuals of Survey ; these are :

1st. The Special Survey.

2nd. The determination of the latitudes of certain points by astronomical observation.

3rd. Exploratory surveys.

4th. The traverse of the C. P. Ry. line through British Columbia.

5th. The subdivision surveys in British Columbia.

6th. The determinations of the longitude of certain points by the interchange of telegraphic signals.

7th. Topograpical Surveys in the Rocky Mountains.

8th. The surveys of Trails in Manitoba and the Northwest Territories.

THE SPECIAL SURVEY.

The Special Survey was begun in 1874. Its object was to establish, by means of a trigonometrical survey, certain additional initial meridians, which it was foreseen would become necessary, owing to the fact that in carrying the surveys west from the Winnipeg or Principal Meridian, the errors would accumulate, and the jogs on correction lines resulting from convergence of the meridians would become very large, and also that the numbering of the ranges would be greater than was desirable.

It was decided that these initial meridians were to be established at equal distances apart, of four degrees of longitude, and that the 1st of the mor the 2nd Initial Meridian was to be in longitude 102° W.

The establishment of the 2nd Initial Meridian was effected by the Special Survey in the above-mentioned manner. The triangulation was commenced at the Winnipeg or Principal Meridian, which had been previously accurately tied in to the post at Pembina, on the International Boundary ; the longitude of this post had been determined by an interchange of telegraphic signals, the work being performed by the officers of the joint commission, engaged in establishing the International Boundary.

From the point of commencement the chain of triangulation was carried across the country by way of Portage Creek, Westbourne, Palestine, Beautiful Plains, Minnedosa, Shoal Lake, Fort Ellice, and Scissors Creek.

The first base was measured at "Grosse Isle," a point near the Principal Meridian about twenty miles north of Winnipeg. Other bases of verification were measured at the "Salt Plains," near Westbourne at "Long Lake," near the Little Saskatchewan, and at Scissors Creek.

Want of space prevents my entering into any lengthy description of the instruments used, the manner of conducting the work in the field, or the results of the same.

It seems a pity that there has never been any complete report published of the operations of this Survey, which may be said to be the first trigonometrical survey of a geodetic nature, effected in Canada.

The 2nd Initial Meridian was established in 1875, and there the trigonometrical survey ended, the establishment of the other Initial Meridians, by means of a triangulation, was given up, as it was expected that the completion of the telegraph line between Selkirk and Edmonton would enable the positions of the other Initial Meridians to be laid down by the method of the interchange of signals over this line.

Owing however to the faulty construction of the telegraph line this method failed, and the 3rd, 4th and 5th Initial Meridians were finally established by surveyors in charge of sections of the Special Survey, who ran base lines through from one Initial Meridian to the next, the distances being measured by check chains.

THE DETERMINATION OF THE LATITUDE OF CERTAIN POINTS BY ASTRONOMICAL OBSERVATION.

In connection with the establishment of the Initial Meridians by the Special Survey, it was decided to determine the latitudes of certain points in the Northwest Territories.

This work was effected by Mr. W. F. King, D. T. S., astronomical assistant on the Survey.

The points at which the observations were made with the resulting latitudes, etc., are here given.

NAME OF PLACE.	LATITUDE.	LONGITUDE.
At iron bar on cross line Parish St. James	49° 53′ 06″40	97° 10′ 41″.51W
Intersection 102nd Mer., & Qu'Appelle Trail	50 22 21.85	102 00 00 "
Battleford, on line S. of Battle River	52 42 38.69	108 16 59.02 "
106th Meridian and Gabriel's trail	52 34 32.69	106 00 00 "
Fort Edmonton, on line W. of Fort	53 31 59.16	113 30 28.6 " 113 32 58 "
Fort Pitt, on River bank S. W. of Fort	53 34 05.28	109 47 10 "
North of Quill Lake near line between Ranges 16 & 17 W. 2nd I.M	52 04 55.88	104 18 14.02 "
On 12th Correction Line, 19 Ranges and 4 sections W. 2nd I. M	53 04 02.38	104 52 28.33 "
On 10th Base, 58½ sections W. of 3rd I.M.	52 11 07.455	107 24 06.24 "
On 11th Base, 27 Ranges and 2½ sections, W. of 3rd I. M	52 32 15.465	109 58 39.45 "
On 14 Base, 64 sections W. 4th I. M	53 35 58.30	111 34 58.53 "
Touchwood Hill trail, on 102nd Mer., 8 sections N. 5th Correction Line	50 42 29.74	101 59 56.77 "
At Swan River Barracks	51 54 21.515	101 57 16.75 "
On Meridian between Ranges 8 & 9 W. 2nd I. M., ½ mile S. 8 Correction Line	51 38 40.70	103 07 57.58 "
Near Ft. Qu Appelle in Valley	50 46 15.51	103 48 02.69 "
McLeod Creek N. of Fort McLeod	49 45 20.64	113 24 00.04 "
On 114th Meridian N. of Bow River near Calgary	51 01 55.71	114 00 00 "
On E. boundary, Range 17 W. 2nd I. M., 11.64 chs N. ¼ sec. post., N. 7 Correction Line	51 18 31.27	104 15 55.17 "
Qu'Appelle Valley on low hills N. of River	50 52 59 58	105 59 21.55 "
On plain two miles N. of Red Deer River near forks with Saskatchewan	50 57 57.62	110 02 43 "

The object in determining the latitudes of the points mentioned above was that the latitudes as determined by the survey might be checked and corrected if necessary, so as to agree with the observed latitudes; this was done, but the results proved far from satisfactory, and judging from the general closings of the Bases in latitude between the Initial Meridians, it would seem that the results would have been better had these corrections not been applied.

This was of course not in any way owing to errors in the latitude observations, but was due no doubt to the great difficulty in making chain measurements agree with observed positions.

EXPLORATORY AND MICROMETER SURVEYS.

Among the surveys, other than those which come properly within the system as provided by the Manual, and which were found at an early date to be necessary, may be mentioned those known as Exploratory and Micrometer Surveys.

The primary objects of Exploratory Surveys are to determine the position, size, and course of important streams and water areas, and to provide data relative to the topographical features of new and unexplored districts. Among the surveys of this kind which have been made, the following may be mentioned:

The explorations in Lakes Manitoba, Winnipegoosis, and Winnipeg, and adjacent waters, by Mr. H. B. Smith, in 1872.

The explorations in Lake Winnipeg and vicinity, by Mr. G. C. Rainboth, D.L.S., in 1872.

The exploratory traverse of the North Saskatchewan River from Edmonton to Prince Albert, by Mr. W. F. King, D. T. S., in 1878.

The explorations which have been carried on in the Saskatchewan, district in 1879 and 1880, by Mr. W. F. King, D. T. S.

The exploratory traverse of the Carrot River, by Mr. A. L. Russel, D. L. S., in 1879.

The exploratory traverse of the North Saskatchewan River between Rocky Mountain House and Edmonton, by Mr. J. C. Nelson, 1880.

The traverse of the trail from Fort McLeod to Fort Qu'Appelle, by Mr. M. Aldons, D. T. S., in 1880.

The explorations by Mr. W. F. King, D. T. S., in the Cypress Hills District, in 1881.

MICROMETER SURVEYS.

The Peace River was surveyed from Fort Chipewyan to Dunvegan, by Mr. Wm. Ogilvie, in 1884.

The Athabasca River was surveyed from Athabasca Landing to Fort Chipewyan, by Mr. Wm. Ogilvie, in 1884.

The Saskatchewan River was surveyed from the Forks to Grand Rapids, by Mr. O. J. Klotz, D.T.S., in 1884.

The Nelson River was surveyed from Lake Winnipeg to Hudson's Bay, by Mr. O. J. Klotz, in 1884.

The Winnipeg, English and Albany Rivers, and connecting waters, were surveyed by Mr. Thos. Fawcett, D.T.S., in 1885.

The shore line of Lake Winnipeg was surveyed by Mr. F. W. Wilkins, D.T.S., in 1886.

Part of the shore line of Lake Winnipegoosis was surveyed by Mr. I. J. Dufresne, D.T.S., in 1887.

The Yukon River from Taiya Pass to longitude 141 W. was surveyed by Mr. Wm. Ogilvie, D.L.S., in 1887.

Part of the Mackenzie River was surveyed by Mr. Wm. Ogilvie, D.L.S., during the past year.

These Micrometer Surveys in many cases, notably those performed by Mr. Ogilvie and Mr. Fawcett, may be said to be original explorations, and in effecting them many obstacles and difficulties had to be overcome.

In his explorations in the Yukon and Mackenzie River Districts during the past two years, Mr. Ogilvie has carried on the most extended and important exploration which has been conducted under the Department of the Interior; and although we can only speak from conjecture as to the many difficulties met with, and hardships to be borne, still we most of us know enough of what explorations in new and unknown districts entail, to realize what Mr. Ogilvie has gone through, and I think the Association should be among the first to congratulate him on his safe return, and the successful accomplishment of the expedition.

THE SURVEY OF THE LANDS WITHIN THE RAILWAY BELT, AND THE TRAVERSE OF THE CANDIAN PACIFIC RAILWAY LINE IN BRITISH COLUMBIA.

When the belt of land extending for twenty miles on each side of the Railway line through British Columbia was acquired by the Dominion Government, a scheme for the survey of lands within the belt had to be devised.

The tract requiring survey being much broken by mountainous ranges, many difficulties were foreseen in attempting to survey the agricultural portion of the belt.

The system which was finally adopted, and the manner of carrying it into effect in the field, has been very exhaustively and interestingly dealt with by Mr. W. F. King, Chief Inspector of Surveys, in his annual report for the year 1886. I will therefore confine myself to a brief reference to the main features of the system and its difference from the system under the Manual of Surveys.

The important change, and the only one in fact requiring special notice, was that the fixed road allowances were done away with, a percentage acreage being provided in each section for this purpose.

As it would be impossible to follow the method laid down in the Manual for the projection of base lines and township outlines, some other primary foundation for the surveys had to be adopted.

The road-bed of the Canadian Pacific Railway through the mountains afforded an easy route for an exact traverse survey, to be used as a base for the subdivision surveys required at different points.

This traverse was effected during the years 1884, 1885 and 1886, by Messrs. Fawcett, Klotz and Ogilvie. The manner in which the work was done has been exhaustively dealt with in the reports of these gentlemen, and the method by which any required point of the subdivision surveys is established from the railway traverse is very clearly shown in the report of Mr. W. F. King above referred to.

THE DETERMINATION OF LONGITUDES BY MEANS OF THE ELECTRIC TELEGRAPH.

In 1885, it was determined to begin the work of establishing the longitude of certain points in British Columbia and the Territories, by an interchange of telegraphic signals.

During that year the longitudes of Victoria, Port Moody and Kamloops were established in that way, and the latitudes of these points were determined by astronomical observation.

The work during this season was performed by Mr. O. J. Klotz, D.T.S., and Mr. Thos. Drummond, D.T.S.

The initial point from which the longitudes were determined was Seattle in Washington Territory, U.S.A.

In 1886, 1887 and 1888, this work was continued, the longitudes of the following points being fixed: Revelstoke, Field, Calgary, Winnipeg. Wapella, Port Arthur, Kalmar, Edmonton, Fort Pitt.

In 1886, Mr. Wm. Ogilvie was associated with Mr. Klotz in this work, and during the past two years the work has been carried on by Mr. W. F. King and Mr. Klotz.

The methods used and the results attained in this work have been thoroughly treated of in the reports of the gentleman engaged on the same, and also in the very interesting papers on this subject read at our last annual meeting by Mr. King and Mr. Klotz; it is therefore quite unnecessary for me to say anything in connection therewith, other than to refer to the work as the most scientific work which has been carried on by the Department.

TOPOGRAPHICAL SURVEY OF THE ROCKY MOUNTAINS.

One of the most interesting surveys, which has been carried on under the Department, is that which comes under the above heading, and has been going quietly on during the past three years.

I understand that a paper, descriptive of the manner in which this survey is being effected, is to be read at this meeting by one of the gentlemen engaged on the work, and I will therefore not attempt to write anything regarding it; in fact in doing so, I would be discussing something about which I know very little other than that a large portion of the mountains have been accurately mapped at a very small cost.

However I feel sure that when the facts regarding this survey are before us, we will be glad to bear testimony to the great credit due the Surveyor-General, for the very able manner in which he has originated this system in Canada and brought it to a successful issue.

THE SURVEY OF TRAILS IN MANITOBA AND THE NORTHWEST TERRITORIES.

Altough our survey system makes a most liberal allowance for public roads, it has been found that in many cases the needs of the settlers would be better served by adapting certain of the old travelled trails or roads, instead of waiting until the road allowances were made practicable.

Many of these old trails follow a very meandering course, and they had to be accurately surveyed so that the necessary right of way could be provided across the lands affected.

The trails are laid out with a right of way, 1 chain in width, and they are carefully tied in to the general surveys.

In making the survey, the surveyors have of course deviated in many cases from the old trail, and have effected many advantageous straightenings of the same.

Up to date the Department have surveyed about—miles of trails in Manitoba and the Territories, and it may be safely said that in no country in the world has there been a more liberal provision made for public highways than in Manitoba and the Territories.

CONCLUSION.

I had intended to refer shortly to the errors which have occurred in the general surveys, and the corrections of the same, but this paper has already exceeded the limits originally intended.

To treat fully of the surveys which have been performed, and to do justice to the subject, would make a good sized volume.

I hope that at some time in the near future we will find the subject receiving the attention which it merits, by the publication of a detailed report of the surveys performed up to date.

The remarks herein contained are offered to the Association, not because they are in any way new to many of the members, but with the hope that a short connected narrative of the surveys since the beginning may be of interest.

J. S. DENNIS.

OTTAWA, February, 1889.

DISTANCE MEASURING MICROMETERS.

The instruments of which I intend here to treat are those telescopes which are provided with proper appliances for measuring distances by comparison of the magnitudes of an object and its image in the telescope.

FIXED THREAD MICROMETERS.

The simplest instrument of this class is the telescope with two threads fixed in the diaphragm. The distance of a point is found by counting the number, included between the two threads, of divisions of a graduated rod, such as a levelling rod, held at the point whose distance from the instrument is required.

Let m be the linear distance between the threads.

Let b be that length of the rod whose image is included between the threads.

Let x be the distance of the rod from the object-glass.

Let u be the distance of the image from the object-glass.

Then since the lines joining the coresponding points of an object and its image must pass through the centre of the object-glass, we have, by similar triangles,

$$b = m \frac{x}{u}$$

And by the optical theory of the convex lens, if f be the principal focal length of the object-glass.

$$\frac{1}{x} + \frac{1}{u} = \frac{1}{f}$$

Eliminating u between these two equations we have

$$\frac{x-f}{f} = \frac{b}{m}$$

Now $x-f$ is the distance of the rod from the *outer* focus of the object-glass.

That is, the reading of the rod is proportional to the distance of the rod from the *outer* focus of the object-glass.

MOVABLE THREAD MICROMETERS.

The next micrometer is that which is applied chiefly to instruments intended for astronomical purposes, but may be used for finding terrestrial distances; that is, a movable thread is placed in the focus of the object-glass, and is moved by a screw having a graduated drum head, and affords the means of measuring the linear dimensions of the image of a rod of known length.

Here, as before, we have

$$x-f=\frac{bf}{m}$$

Here m is the variable reading instead of b, so in this case also the distance must be measured from the outer principal focus of the object-glass, and the reading is inversely proportional to this distance.

ROCHON MICROMETERS.

We now come to two-image micrometers, of which the first to be considered is the Rochon Micrometer.

In this micrometer a doubly refracting prism is placed behind the object-glass, so that part of the rays are intercepted in their passage to the eye-piece, and turned through a constant angle and thus are formed two complete images of the rod. By sliding the prism from or toward the object-glass, these images are made to approach or recede from each other, and the observation is made by reading from a scale along the telescope tube the position of the prism in the tube.

Using x, b, f, m, and u, to represent the same quantities as before, and calling the distance from the object-glass to the image, l, and the constant angle, θ, we have the distance between two images, or $m=(u-l)\tan\theta$.

$$\text{so that } \frac{u}{x}=\frac{(u-l)\tan\theta}{b}$$

$$\text{and } \frac{1}{x}+\frac{1}{u}=\frac{1}{f}$$

Whence, by eliminating u,

$$\frac{x-f}{f}=\frac{b-f\tan\theta}{(f-l)\tan\theta}$$

Or the distance of the object from the *outer* focus varies inversely as the distance of the prism from the *inner* principal focus $(f-l)$.

LUGEOL MICROMETERS.

Next we come to the Lugeol Micrometer, where the division of the images is effected by a separation of the two semicircular halves of the object-glass, by means of a micrometer screw.

Let m be the distance apart of the two half lenses, x the distance of the object, u the distance of the image from the object-glasses, b the length of the rod. Then since when the two images are brought into end contact the straight lines joining the extremities of the rod with the centres of the lenses must meet in the point of contact of the images, we have

$$\frac{x+u}{u} = \frac{b}{m}$$

$$\text{and} \quad \frac{1}{x} + \frac{1}{u} = \frac{1}{f} \quad \text{or} \quad \frac{x+u}{u} = \frac{x}{f}$$

$$\text{whence} \quad x = \frac{bf}{m}$$

or the distance from the object-glass is inversely proportional to the reading.

GENERAL REMARKS.

There are other forms of micrometers such as the divided eye-piece micrometer, &c., but the above are those commonly met with.

Any theodolite or level instrument may be used as the first kind of micrometer, and good results can be got at short distances.

The movable thread micrometer is not so convenient for use, and a serious fault in all thread micrometers is the uncertainty due to the coarseness of the thread.

Of the double image micrometers, the Lugeol is to be preferred to the Rochon, because with the latter, the images are usually of unequal brightness, and it is therefore difficult to make a proper contact.

I shall now consider the effect of small errors in the instruments and in the readings on the calculated distances.

For all the micrometers

$$x = \frac{bf}{m}$$

where x is the distance of the object, measured from the object-glass in the Lugeol Micrometers, and from the outer principal focus in the other three.

b is the length of the rod, which must in the case of the Rochon be diminished by the constant quantity $f \tan \theta$, f is the principal or sidereal focal length, m is the separation of the two half object-glasses in the Lugeol, and the size of the image in the two thread micrometers and in the Rochon $(f-l) \tan \theta$ or the linear separation of the images of an infinitely distant object, such as a star, with the prism in the actual position which it occupies duiring the distance measurement.

Assuming the focal length to remain constant, and calling the small increments of x, b, and m, δx, δb, and δm, we have by differentiating

$$\delta x = \frac{f}{m}\delta b - \frac{bf}{m^2}\delta m$$

which may be written

$$\delta x = \frac{f}{m}\delta b - \frac{x}{m}\delta m$$

which in the first mentioned micrometer, where b and x are the variables and f and m constants, means that the error in distance is proportional to the error in reading the graduated rod; and the error in distance due to error in the bisection of the marks on the rod by the threads varies as the distance.

The above differential formula may also be written

$$\delta x = \frac{x}{b}\delta b = \frac{x^2}{bf}\delta m$$

so that in the other micrometers, where x and m are the variables, the error in distance due to a given error in measured length of the base varies directly as the distance, and that due to error in the reading (m) varies as the square of the distance. In the Rochon m or δm is the reading or error in reading mutiplied by tan θ, provided the graduation, as above supposed, is along the tube of the telescope.

These formulæ may be used to find the actual error caused by errors in the data, in the following manner:

A Lugeol micrometer, the parts of which I have measured, has a a focal length of about 13 inches. The shaft of the micrometer head has two screw threads, whose pitches were right and left hand respectively, the pitch of one being about $\frac{1}{31}$ of an inch, and of the other $\frac{1}{38}$ of an inch, so that one turn of the head moves the two half object-glasses apart $\frac{1}{31}+\frac{1}{38}$ of an inch, about $\frac{1}{17}$ of an inch. The drum-head is divided into one hundred parts, so that one division corresponds to $\frac{1}{1700}$ of an inch.

Now suppose the distance to be 40 chains, the length of the base 15 links, and an error of one division to be made in the reading, so that $\delta m = \frac{1}{1700}$ of an inch.

Then the formula $\frac{x^2}{bf}\delta m$ gives for the error δx, of x, in chains

$$\frac{40^2}{\frac{15}{100}\times\frac{13}{792}} \times \frac{1}{1700\times 792} = 0.48 \text{ or } 48 \text{ links}$$

For the Rochon Micrometer we have

$$\frac{x-f}{f} = \frac{b-f \quad \tan\theta}{(f-l)\tan\theta}$$

Now f can be measured directly if an observation be taken on a base of known length at a known distance, so that b and x are known, then l can be measured, and thus $\tan\theta$ can be got, the constant angle for this instrument.

Thus if x be 19.05 chains, $b = 15$ links, f 16 inches, and $f - l$ be found to be 11.7 inches, we get $\theta = 36°$ as the constant angle.

The differential formula may then be used

$$\delta x = -\frac{x^2}{bf}\,\delta m = -\frac{x^2}{bf}\tan\theta\,\delta r$$

when δr is the error of the scale reading on the telescope tube.

Suppose the error of reading to be $\frac{1}{20}$ of an inch.

Then with the above constants, for $x = 40$ chains we have

$$\delta x = 35 \text{ links approximately.}$$

The length l from the object-glass to the point of separation of the rays in the prism, is difficult to measure directly ; but if we have two readings taken on the same rod at distances x and x^1, the corresponding readings being l and l^1, $l - l^1$ may be readily measured, and we have

$$l = f - \frac{f}{x - f}(b\cot\theta - f)$$

$$l^1 = f - \frac{f}{x^1 - f}(b\cot\theta - f)$$

whence we have

$$l - l^1 = f(b\cot\theta - f)\left\{\frac{1}{x^1 - f} - \frac{1}{x - f}\right\}$$

so that $l - l^1$ being known as well as x and x^1, we have an equation to determine θ.

In this manner we get the error in distance due to a given error in reading.

So if we assume a probable error of reading of one division of the micrometer head in the Lugeol, or a certain fraction of an inch in the Rochon, we get the probable error of a distance determination.

From this can be found the probable error of the distances of a traverse or the total probable error. This total probable error being equal to the square root of the sum of the squares of the probable error of each line.

It should be noticed, however, that there is a great likelihood of errors of reading being due to constant causes, such as imperfect optical definition, or lost motion of screws, so that the errors may be cumulative, and may not tend to counteract one another as is assumed in the theory of least squares.

The theory of the Lugeol micrometer, as above, gives the distance of the object as inversely proportional to the reading. This is not quite true in practice. See Mr. Klotz and Mr. Ogilvie's papers on the subject, read before this Association two years ago. It would be worth while to make experiments, to determine whether these differences are due to refraction, or to some other cause.

I have no data to shew whether the theory I have given for the Rochon Micrometer holds good in practice.

ANALLATIC LENS.

In the Stadia micrometer, the first of the above forms, a second lens is frequently placed behind the object-glass, the effect of which is to bring the point from which the distances are to be measured from the outer principal forms to the centre of the telescope tube, or to any other point which may be required.

As above we have for the distance of the object from the object-glass

$$x = f\left(1 + \frac{b}{m}\right)$$

Now suppose a second lens introduced into the tube of the telescope, at a distance a behind the object-glass, and having a focal length f^1, let v be the distance of the former image behind this lens, v_1 the distance of the new image, m and m their sizes.

Then we have

$$\frac{1}{v_1} - \frac{1}{v} = \frac{1}{f_1}$$

$$\text{also } \frac{v_1}{v} = \frac{m_1}{m}$$

$$\frac{m}{m_1} - 1 = \frac{v}{f_1}$$

$$\text{and } \frac{1}{x} + \frac{1}{v+a} = \frac{1}{f} \text{ whence } v = \frac{fx}{x-f} - a$$

$$\text{also } x = f\left(1 + \frac{b}{m}\right) \text{ whence } m = \frac{bf}{x-f}$$

So we get

$$\frac{bf}{m_1(x-f)} - 1 = \frac{f\,x}{f_1(x-f)} - \frac{a}{f_1}$$

$$\text{whence } x + \frac{f\,(a-f_1)}{f+f_1-a} = \frac{bff_1}{m_1(f+f_1-a)}$$

Here $x + \frac{f(a-f_1)}{f+f_1-a}$ is the distance of the object from a point at a constant distance behind the object-glass. This distance by varying a can be made anything we like, as for instance the point of suspension of the telescope, and then the distance from that point will be directly proportional to b, that part of the rod the image of which is included between threads at a constant distance m.

The second lens is called the anallatic lens. It is usually so placed as to bring the measuring point at or near the point of suspension of the telescope. It is usually adjustable, so that it can be moved along the tube. It may then be used to adjust the ratio of b to m, so that some exact number of division of the rod may be made to correspond to an exact number of chains distance, so as to simplify the readings of distance with the instrument, and this is the usua purpose of the adjustment.

W. F. KING.

REGARDING GEOGRAPHICAL NOMENCLATURE.

An active connection for many years with the enterprises in the Northwest, as well as in the investigation of the geographical description of plants in all the provinces, has long since led me to see the necessity of some statutory regulations, under which not only the duplication of names, so frequent especially in the Northwest, would be remedied and rendered impossible in the future, but the use of grossly absurd and inapplicable names would be prevented, and the whole subject of Geographical Nomenclature of Canada brought under systematized control. It was not, however, until 1887, that I ventured to bring the matter before the late Honorable Thomas White, then the Minister of the Interior, who with Mr. Burgess, the Deputy Minister, entered heartily into the consideration of the subject, and I am glad to find it has been taken up with equal heartiness by this Association, and I have reason to believe by the present Minister of the Interior.

That the subject needs immediate attention is clear to us. Topographical, Railway and Geological surveys are being yearly conducted on a large scale in the Northwest, and in the less known parts of the older Provinces. New geographical features are being constantly mapped out, and older and more imperfectly known features accurately traced. Population is gradually following on, and new post offices are being continually demanded, especially in the newer districts, whilst railways are being pushed into the less settled sections, and new stations—the forerunners of future villages and towns—are being established every few miles along their track. At present there is nothing to prevent duplication or the use of objectionable names ; but it is the privilege of every explorer and map maker, however ignorant he may be of the country at large, or however coarse in his nature—to originate new names. Hence we have duplications in large numbers, and some names of so low a character that we may well feel ashamed of them, and every map that is issued is aiding in giving permanency to such names.

Cases are also constantly occurring where the local name familiar in the surrounding district is either changed or added to, by those who map out the same and who will not take the trouble to ascertain or will not recognize the names of prior right. And all these names are to be the property of our descendants as well as ourselves, and will be perpetuated in the thousands of deeds and documents which will be executed, and in the numerous maps and books that will be published, in coming years, when change will become more difficult and impossible.

While there can be no question that duplicate names, in at least Manitoba, the Northwest and British Columbia, should be at once altered, it is more difficult to deal with mis-appropriate and ill-sounding names. It is not generally advisable to change a name which has become familiar, because it is unsuitable or is not euphonious; Wherever, however, it shocks the moral senses, or is simply barbarous, alteration ought to be made.

There should be no excuse afforded for such names appearing in publications circulated in a civilized community ; and yet we find Stinking River, Drunken River, Cow Dung Lake (which gave its name to a pass, now fortunately better known by its alternative name of Yellow Head Pass), Death's Door Point, Kicking Horse Pass, and many other objectionable though perhaps less offensive names, appearing on maps issued by the State.

In the present paper, I merely propose supplementing, by a few brief suggestions the proposals made last year in the published report of the Committee of the Association, as follows :—The whole matter might be entrusted to a Commission, comprising a representative of each of the Departments of the Interior, and the Post Office, and to these full powers should be given, and the subject grappled with in its entirety. It is not sufficient that the Department of the Interior should be dealt with, the co-operation of the Post Office should be obtained, in order to secure system in the naming of the many hundreds of new Post Offices which in coming years will be demanded.

The Department of Crown Lands in Ontario, Quebec and British Columbia should also be induced to interest themselves, since the more northern parts of each of these Provinces are to a large extent unexplored, and it is most desirable that in the progress of surveys there, the system of naming new physical features should be uniform with that of the Dominion. Supervision must go even further. There must be sufficient control exercised in matters of Nomenclature, over both the publishers of local maps, and the management of railways.

The rule should be enforced by a statute, that newly observed geographical features, recently surveyed townships in the Northwest, proposed post offices, and new railway stations on railways subject to the Dominion control, should receive only those names which have been approved by the Commission.

The name proposed by the discoverer of a new geographical feature should be given a preference if it is suitable, but care should be taken before approval is given, that no suitable name of prior recorded right, or known to be familiar in the neighborhood, is thereby suppressed.

Where a name is suggested by some characteristic feature, as in the case of a mountain range, lake, or river, the feature should characterize the whole or the greater part of it, and not be a mere localism.

It cannot be too often repeated that the Indian names, where they are euphonious and not too long, should be retained ; with the different Indian languages and dialects there is a wide field for names, and no danger of repetition, although the words rendered in English may mean the same in many instances.

Present objectionable names are probably mere translations of original Indian names, which the better second thought and better sense of the explorer would have well left alone.

Duplication even of post offices in different Provinces should be strictly avoided.

Where duplication has already taken place in geographical features in Manitoba and the Northwest territories, it should be remedied at once, before the increase in the population, and the fixing of the names amongst the people of the locality render change difficult and impossible. In the other provinces the attention of the local Government should be drawn to it, with a view to remedy measures there as far as feasible.

The friendly co-operation of all the provinces of the Dominion and of all railways subject to Provincial control should be sought in carrying out the general object of the Commission.

Names which are barbarous or morally objectionable should be changed without delay.

Before authenticating any name by giving it a place in the proposed Official Geographical Dictionary, great care should be taken to correctly ascertain its spelling, syllabication and accentuation, this being particularly necessary in words of Indian and French derivation, amongst which very many errors in this respect are believed to exist.

It would also add considerable further interest if the special reason, which occasioned the giving of each name, should be put on record, whenever it can be ascertained.

When alterations are determinated on, the expunged name should appear alongside the new name, within brackets, in the first official maps published thereafter, so as to accustom the public to the alteration.

A. T. DRUMMOND.

MONTREAL.

SURVEYS OF THE PROVINCE OF QUEBEC.

The earliest records we have of surveys in the Province of Quebec are those of the fiefs and seigneuries conceded by the King of France to subjects who had, in some way, distinguished themselves in active service on this continent.

The title in virtue of which these seigneuries were conceded being translated was as follows:—

"To all whom these present letters may be seen, be it known on the petition to us presented by Denis DeLaronde, Chevalier, of the Mititary Order of St. Louis, Captain of Marine, in the service of the King. It pleases us to accord the territory of two leagues in front along the River Chambly, by three leagues in depth, and a little island above the Island aux Tests. The said two leagues in front to be taken from the boundary of the seigneurie newly conceded to M. De Levy, ascending towards Lake Champlain, in which territory is the river called Lacolle; thewhole to be held as a fief and seigneurie, with the right of high and moderate justice, right of fishing and hunting, and effecting treaties with the Indians, as well without as within the said territory; wherefore we, having regard to and in virtue of the power to us jointly given by His Majesty, have given, accorded and conceded, give, accord and concede to the said De Laronde, the said extent of two leagues of territory in front by three leagues in depth, thus and in the manner as it is above described, which said extent of territory shall be bounded on the north side by the seigneurie newly conceded to De Levy, and on the same line, and on the south by a line drawn east and west of the world, in front by the River Chambly, and in the rear a distance of three leagues joining the unconceded territory, including the little island which is above Tests Island, to enjoy by himself his heirs and assigns a perpetuity and forever, as a fief and seigneurie high and moderate justice, the right of fishing and hunting, and treaty with the Indians, within the whole extent of the said concession, subject to the charge of fealty and homage at the castle of St. Louis, etc." *Seigneur*, taken in connection with *Seigneurie*, signifies a proprietor of a *fief*, or extent of territory, to whom certain rights and duties are due from those who hold under him, and a *fief* is a heritage held from the King or other *Seigneur*, subject to fealty and homage, and the performance of other rights. *Fiefs* are held by different titles which determine the duties of the holder in each case, and differ greatly from lands held in free and common soccage, which are exempt from all seigniorial rights. These different marks of what is known as the direct *Seigneurie* have now disappeared, and the only privileges of the *Seigneur* are to be found recorded in an act respecting the general abolition of feudal rights and privileges. *Seigneuries* in the Province of Quebec were held *en roture*, by which is meant, land held subject to an annual rent or *cens* and *lods et ventes*.

The surveyors in those days were commissioned and styled "*Arpenteurs du Roi*," who acted under order of the Intendant, but were virtually in the employ of the *Seigneurs*. The first *fief* and *seigneurie* conceded dates back to February, 1626, and the last to the year 1755, the number whereof according to the best authority is 586. Those situated on the River St. Lawrence were established by *règlement* of 1676, northwest and south east astronomically, excepting a few on the north shore near Quebec which were made to run N. W. by N. or N. 33¼° W.

In the same way the side lines of the *seigneuries* of the Ottawa River were made to run N. by W., or N. 11¼° W., being about at right angles to the general course of the River. These surveys were performed in general by the "*boussole*" or surveyor's compass, which at that time appears to have been similar to the Mariners Compass, allowance being made for the declination of the needle. The measure used being "*pieds du Roi*," or French foot, which in comparison with our English measure, one foot French=1.06576542 English feet.

These surveys, in general, are fairly correct, excepting in a few cases, where the proper amount of declination appears to have been either deficient or in excess of quantity. These *fiefs* and *seigneuries* were in due time subdivided, with a view of protecting the settlers from the incursions of the savages at that time, in long and narrow lots, laid out in front ranges and in double concessions, in order that the settlers might be situated as closely as possible, in case of surprise from the enemy. We find this same method of survey employed by Lord Selkirk in 1811, in the settlements on the Red River in Manitoba, and which appear to have answered the requirements of the time.

The year 1760 brought to a final close the era of French dominion in Canada, and peace was concluded between Britain and France in 1763, when Canada was formally ceded to England. In the same year a small portion of the recently acquired territory was organized by royal proclamation under English laws. The same year we find a copy of a Survey Warrant by Governor Murray to Captain

Samuel Holland, "Surveyor of the Province of Quebec," directing him to survey a tract of land at Murray Bay, for Ex-Lieutenant Malcolm Frazer, of the 78th Regiment; these are the oldest instructions on record.

In the following year, March 6th, 1764, the appointment of Captain Samuel Holland, Esquire, Surveyor-General, for making a survey of the northern district upon the Continent of North America took place.

Following the appointment we find a copy of a memorial of Surveyor-General Holland, addressed to the Right Honorable the Commissioner of Trade and Plantations, which may perhaps not prove uninteresting, and reads as follows:

"Proposals for carrying on the General Survey of the American Colonies.

The general survey shall be made on a scale of one mile to an inch, the places of note—channels, harbors, &c.—by a scale of four inches to the mile, being four times larger; the sounding of all harbors and channels shall be taken with a natural and historical description of the countries, the rivers and lakes, and whatever other remarks may be thought necessary. The Latitudes and Longitudes of all capes, headlands, &c., shall be determined by astronomical observation.

It will be necessary to have orders for all the Provincial Surveyors in the Department to give their assistance, and also copies of their surveys already made which are in their possession.

An armed cutter or other small armed vessel will also be wanting, with two whale boats and one large long boat, which will also serve to transport the party over bays and arms of the sea, and may be used in the River St. Lawrence, against smuggling, and to prevent the French from trading on the Continent.

The following is an estimate of the pay of Assistants and other expenses without which the service cannot be carried on:

	Per annum.		
	£	s.	d.
For a Deputy Surveyor to be left to act in Quebec, that the Memorialist may not lose the emolument of his office, nor the Provincial Surveyor of the Colony by his absence	100	0	0
Two Assistant Surveyors at 7s. per day each	254	10	0
One draughtsman at 5s. per day	91	5	0
One Sergeant, one Corporal and 12 men to serve as Camp Colour and Chainmen, and to make signals along shore and on tops of mountains, viz:			
One Sergeant 18d. per day (additional)	27	7	0
One Corporal 1s. " " do	18	5	0
12 men 6d. each do	109	10	0
Extraordinary expenses for horses, guides, etc., to be accounted for	100	00	0
Total	£700	00	0

For making the survey with a proper degree of exactness, the following instruments will be necessary, the price of which is annexed to each:

	£	S.	D.
An Astronomical Quadrant	21	0	0
A Micrometer	5	5	0
A Theodilet with vertical arch and Telliscope divided to every minute	30	0	0
Three pocket Theodiletts at £1 10s. each	4	10	0
One small Teliscope divided to every minute	20	0	0
One Azimuth Compass	4	14	6
One 12 inch Round Proctractor with index and nones to every minute	2	12	6
One Hadley's Quadrant 18 inches radius	4	14	6
One Telescope and Rules	5	5	0
Mr. Short's Reflecting Telescope 24 inch focal length with Rockworth stand	36	15	0
Skelton's Clock or timepiece for Astronomical observations	40	0	0
A pair of globes 17-inches	6	6	0
A copying glass	2	2	0
3 brass chains, 50 feet each	3	3	0
Stationery, wares, drawing paper, &c.	15	0	0
Total	£201	7	6

According to the foregoing estimate as the instruments will serve for the whole survey, the expense will not amount to £700 a year, and in 5 years at the furthest surveys of all the coasts, rivers and bays, and such parts of the lands as can be settled for many years to come, will be finished, at which time this additional expense may cease, if the Government shall not think it necessary to prosecute the plan of survey of the whole northern district.

The Memorialist has the honor to subscribe himself,

My Lords,
Your Lordships' most obedient and most humble Servant,
SAMUEL HOLLAND."

These proposals were, it appears, accepted and the trigonometrical survey of the St. Lawrence was proceeded with; but owing to hostilities with the Americans, it was somewhat retarded, and was only completed in 1780.

The position and limits of *seigneuries* were defined, as well as other reserves along the River from Bic upwards to the Gallop Rapids.

The greater part of the Ottawa River was surveyed in 1789 and 1790.

The earliest township plan on record is dated September 2nd, 1765 by John·Collins, Deputy Surveyor, being a plan of Port Daniel, Bay of Chaleur; scale 400 feet to the inch, is laid out in ranges, at right angles to the Bay, and in lots of 50 acres each 742 by 2935½ feet; then follows the Township of Gaspé Bay North in 1785, Ashford in 1791, and Ascot in 1793. These townships were only partially surveyed, were outlined, and two or three ranges laid off. These latter were on a scale of 40 chains to one inch.

A copy, diagram E, may be seen in the Record Office, approved 30th May, 1794, by the Governor in Council, consisting of 11 ranges of 28 lots in each range, 75.5 by 28.75 chains, and of 200 acres each. This appears to have been about the standard at that time for townships, and some 50 were thus laid off in the Eastern Townships. At a still later date, however, this form was slightly changed, and an allowance of 5 per cent. for highways allowed, which form is still adhered to. On September 11th, 1783, Mr. Collins, Deputy Surveyor, was instructed to lay out lands at Cataraqui for the "United Empire Loyalists"; these were laid out in townships of 6 miles square, and subdivided into lots of 120 acres each, in order to suit the settlers, who appear to have been used to that form.

Surveyor-General Holland was succeeded by Joseph Bourchette, Esq., who was promoted Surveyor-General in 1804. This office was abolished in the year 1845, and was superceded by that actually known as Commissioner of Crown Lands, who controls all work formerly exercised by the now defunct office of Surveyor-General, The work of the Commissioner of Crown Lands, relating to Crown Lands Surveys, is more immediately under the control of the Deputy of the Commissioner, which important office is now held by E. E. Taché, Esq., a most accomplished, painstaking and thoroughly practical man, to whose kindness and urbanity, and that of F. X. Genest, Esq., I am largely indebted for a great deal of the data contained in this paper.

At the time that Mr. Bourchette acceded to office, the surveys were still performed with circumferentors, a primitive instrument provided with sights, and the bearings taken from the magnetic needle. It now became important that greater precision should be taken, consequently meridians were established at certain important local points, for the purpose of ascertaining the variations of the compass at each locality. With the increase of surveying operations, the use of improved instruments were introduced, and about the year 1830, the theodolite with telescope came into general use. Other surveys were subsequently effected with instruments of a higher order of precision, establishing greater scientific knowledge of the requirements of the profession. The first official act of importance undertaken by Mr. Bourchette, after his appointment to office, was to establish the boundaries of the different seigneuries previously conceded and held as such, so as more definitely to determine their separation from the Crown Lands. Other surveys were undertaken at the instance of the Government for the various purposes of Colonization, but are too well understood to call for any special remark. Base lines were early recognized as of great importance, in establishing starting points in surveying operations, and facilitating the work of the surveyor. They originated first in connection with the laying out of townships, and were adopted for a similar object in the concessions made of timber limits, for lumbering operations, the utility of which in such connection will be easily understood by the practical professional.

The most important surveys undertaken in recent years by the Province of Quebec were those concerning the cadastration of the cities, towns, parishes, townships and incorporated villages of the Province of Quebec. The importance of this work can scarcely be overrated, it was undertaken for the purpose of facilitating the identification of lots, for the purpose of registration of real rights affecting real estate. The law under which it was undertaken provides that when a copy of the plans and book of reference for the whole of a registration division has been deposited in the office for such division, and notice has been given by proclamation in the manner provided by law, the number given to a lot upon the plan and in the book of reference becomes a true description of such lot and is a sufficient description of such lot in any document whatever. The mode followed in the cadastration alluded to is to give to each lot, according to its previously existing dimensions, the number originally borne by such lot in the townships only, and in similar work performed in parishes, cities, towns and villages, by substituting a new series of numbers for the old ones, and any description in any document whatever of such lot, by its cadastral number, is a sufficient designation and identification thereof.

The book of reference prepared likewise by the surveyor, in connection with the survey, contains a more minute description of the lot by giving a description of the confines thereof, together with the boundaries and the quantity of land contained within such defined limits, including in separate columns the number of the lot or piece of land indicated on the official plan, and the name of the proprietor.

There is another authoritative mode of survey, which I believe is confined in its operation, and is peculiar to the Province of Quebec I allude to the surveys undertaken and performed in all cases arising under an action, known to the laws of the Province of Quebec as actions *en bornage* or actions of boundary, or to verify or rectify ancient boundaries, and take place under the authority of the Court before which such action is instituted, and occur whenever two contiguous lands have never been bounded, or the boundaries have disappeared, or the fences or boundary works have been wrongly placed, and one of the neighbors refuses to agree upon a surveyor to determine the boundaries, or to verify or rectify the division line, as the case may be, or one of the parties interested, having consented to have such survey performed, afterwards refuses to sign the *procès verbal* of such survey, determining the line between the adjoining properties. The duty of the surveyor in all such cases is to be guided by the respective titles of the parties produced, if any, and such instructions as may be given by the judge, according to the contestation raised. In virtue of such authority, the surveyor proceeds to run a line strictly adhering to the orders given him by the Court, and makes a report of his work, to which is annexed a plan which he addresses and returns to the Court. This report, which is usually found to contain the division line between the contestants, as revealed by their respective titles or legal pretensions and rights, is subsequently, if found correct, homologated by the Court, and irrevocably establishes the division between such parties. It frequently happens that a surveyor in the execution of his work is called upon to act *quasi judicially*, by taking the evidence under oath of any person or persons in a position to establish the locality of an ancient post or boundary which may have disappeared. Whenever any such contingency arises in connection with the survey, special mention thereof is made in a *procès verbal*, drawn up by the surveyor, to which is attached the evidence so taken.

In conclusion, I may say that the various duties assigned to the surveyor and incumbent upon him, in the discharge thereof, involve great responsibility in the faithful and intelligent performance of the same, and ought to stimulate one and all to discharge their important functions in a manner to reflect the greatest possible credit on the Profession, and attract towards it the respect and confidence of the public.

G. E. McMARTIN.

LIST OF MEMBERS.

HONORARY MEMBERS.

BELL, ROBERT, B.A. Sc., C.E., M.D., LL.D., Assistant Director of the Geological and Natural History, Survey of Canada.
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BOULTON, J. G., Staff Commander, R.N., engaged in the Hydrographic Survey of the Georgian Bay of Lake Huron.
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DAWSON, GEORGE MERCER, D. Sc., Assoc. R.S.M., F.G.S., F.R.S.C., Assistant Director of the Geological and Natural History Survey of Canada.
Geological Survey, Ottawa, Ont.

DEVILLE, CAPT. E., F.R.A.S., D.T.S., F.R.C.S., Surveyor General, Pres. of Board of Examiners for D.L. & D.T.S.
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Walbrae Place, University St., Montreal, Que.

KING, W. F., D.T.S., B.A., Chief Astronomer to the Department of the Interior, Member of Board of Examiners for D.L. & D.T.S.
Department of the Interior, Ottawa, Ont.

MACOUN, JOHN, M.A., F.L.S., F,R.S.C., Botanist and Naturalist to the Department of the Interior.
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MAGRATH, BOULTON, Inspector of Schools, Member of Board of Examiners for D.L., & D.T.S.
Aylmer, Que.

SELWYN, ALFRED R. C., C.M.G., LL.D., F.R.S., Director of the Geological and Natural History Survey of Canada.
Geological Survey, Ottawa, Ont.

TACHÉ, E. E., Assistant Commissioner of Crown Lands, Quebec.
Crown Lands Department, Quebec.

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ABREY, GEORGE BROCKITT, Provincial Land Surveyor for Ontario.
17 Yonge street Arcade, Toronto, Ont.

BEATTY, WALTER, Provincial Land Surveyor for Ontario.
Delta, Ont.,

Belleau, Joseph Alphonse, Provincial Land Surveyor for Quebec, Draughtsman, Department of Interior.
87 Water Street, Ottawa, Ont.

Bigger, C. A., Provincial Land Surveyor for Ontario.
Ottawa, Ont.

Bourgault, Charles Eugene, Provincial Land Surveyor for Quebec.
St. Jean Port Joli, Que.

Bowman, Herbert J., Provincial Land Surveyor for Ontario.
Berlin, Ont.

Brabazon, S. L., Provincial Land Surveyor for Quebec.
Portage du Fort, Que.

Brabazon, A. J., Provincial Land Surveyor for Quebec.
Portage du Fort, Que.

Bray, Edgar, Provincial Land Surveyor for Ontario.
P.O. Box 165, Oakville, Ont.

Bray, Samuel, Provincial Land Surveyor for Ontario, C.E., Indian Department.
Ottawa, Ont.

Breene, Thomas, Civil Engineer, etc.
Corner of Rampart and Ste. Famille Streets, Quebec, Que.

Brownlee, J. H., Provincial Land Surveyor for Ontario and Manitoba, Map Publisher, etc.
Brandon, Man.

Chalmers T. W., 1st Class, Royal Military College, Kingston, Inspector Northwest Mounted Police.
Battleford, N.W.T.

Chipman, Willis, B.A.Sc., Mem. Canadian Soc. C.E., City Engineer, Provincial Land Surveyor for Ontario.
Brockville, Ont.

Cozens, Joseph, Provincial Land Surveyor for Ontario.
Sault Ste. Marie, Ont.

Crawford, William,
Winnipeg, Man,

De Chesne, Ludger Miville, Provincial Land Surveyor for Quebec.
Village des Aulnets, St. Roch, L'Islet, Que.

Dennis, J. S., D.T.S., Inspector of Surveys, Department of the Interior.
Ottawa, Ont.

Doupe, J. L., B.A., Provincial Land Surveyor for Manitoba.
Winnipeg, Man.

Drewry, William S., Provincial Land Surveyor for Ontario.
Belleville, Ont.

Driscoll, Fred.,
Alymer, Que.

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993 Sherbrooke Street, Montreal, Que.

DUMAIS P. T. C., Provincial Land Surveyor for Quebec.
Hull, Que.

DUFRESNE, I. J., D.T.S., Member of Board of Examiners for D.L. & D.T.S., Provincial Land Surveyor for Quebec.
St. Thomas de Montmagny, Que.

FAWCETT, THOMAS, D.T.S., Provincial Land Surveyor for Ontario.
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176 Argyle St., Toronto, Ont.

FREEMAN, N. A.,
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GARDEN, JAMES F., Provincial Land Surveyor for Ontario.
Vancouver, B.C.

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Collingwood, Ont.

GORE, THOMAS S., Provincial Land Surveyor for Ontario.
Victoria, B.C.

GREEN, THOMAS D , Provincial Land Surveyor for Ontario.
Department of Indian Affairs, Ottawa.

HARRIS, J. W., City Surveyor, Assessment Commissioner, Secretary P.L.S. Association and Board of Examiners for P.L.S. of Manitoba,
Winnipeg, Man.

HENDERSON, WALTER, Provincial Land Surveyor for British Columbia.
Chilliwhack, B.C.

IRWIN, HENRY, B.A.L.C.E., Trinity College, Dublin, Provincial Land Surveyor for Quebec, Assist. Engineer C. P. Railway.
103 Union Avenue, Montreal, Que.

KIRK, JOHN ALBERT, Provincial Land Surveyor for Ontario.
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KLOTZ, OTTO JULIUS, D.T.S., C.E., Astronomer, Department of the Interior, Member of Board of Examiners for D.L. and D.T.S.
P.O. Box 101, Preston, Ont.

LAURIE, RICHARD CAMEY, Provincial Land Surveyor for Manitoba.
Battleford, Saskatchewan Dist., N.W.T.

MADDOCK, JAMES ARTHUR, Provincial Land Surveyor for Ontario.
Gladstone, Los Angeles, California, U.S.A.

MAGRATH, CHARLES A., D.T.S., Land Commissioner, Northwest Coal and Navigation Co.
Lethbridge, Alberta Dist., N.W.T.

MOUNTAIN, GEO. A., Provincial Land Surveyor for Ontario, Chief Engineer of Canada Atlantic Railway.
Coteau Landing, Que.

Morency, D. C., Member of Board of Examiners for D.L. and D.T.S., Provincial Land Surveyor for Quebec, Inspector of Surveys, P.Q.
Levis, Que.

Murdoch, William, Deputy Surveyor of Lands, Province of New Brunswick, Civil Engineer.
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McAree, John, D.T.S., Grad. School Practical Science, Provincial Land Surveyor for Ontario, Mining Engineer.
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McArthur, J. J., Provincial Land Surveyor for Quebec.
Aylmer, Que.

McLatchie, John, Provincial Land Surveyor for Ontario and Quebec.
New Edinburgh, Ottawa, Ont.

McMartin, Geo. Erastus, Provincial Land Surveyor for Quebec.
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McVittie, A. W., Provincial Land Surveyor for Ontario.
Fairmont, Kootenay Dist., B.C.

Nelson, J. C , Department of Indian Affairs, Ottawa.
Regina, N.W.T.

Niven, Alexander, Provincial Land Surveyor for Ontario.
Haliburton, Ont.

Ogilvie William, Provincial Land Surveyor for Ontario.
Gloucester, Ont.

Ord, Louis Redmond, Civil Engineer.
City Point, Indian River, Florida, U.S.A.

Pearce William, Provincial Land Surveyor for Ontario, Superintendent of Mines, Member of Board of Examiners for D.L. and D.T.S.
Calgary, Alberta Dist., N.W.T.

Purvis Frank, Provincial Land Surveyor for Ontario, Municipal Engineer.
Eganville, Ont.

Poudrier, A. L., Provincial Land Surveyor for Quebec.
Donald, B.C.

Patten, T. J., Provincial Land Surveyor for Ontario.
Little Current, Ontario.

Rauscher, R., Provincial Land Surveyor for Quebec, Department of the Interior,
Ottawa, Ont.

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St. Thomas de Montmagny, Que.

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Selby, Henry W., Provincial Land Surveyor for Ontario.
Stayner, Ont.

Sewell, H. DeQ., Provincial Land Surveyor for Ontario, Mining Engineer.
Port Arthur, Ont.

SNOW, J. F., Provincial Land Surveyor for Ontario and Quebec.
Ottawa, Ont.

STARKEY, S. M., Provincial Land Surveyor for Quebec.
Starkey, N.B.

STEWART, LOUIS BEAUFORT, D.T.S., Provincial Land Surveyor for Ontario.
Banff, Alberta District, N.W.T.

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P.O. Box 89, Aylmer, Que.

ST CYR, ARTHUR.
Ste. Anne de la Pérade, Que.

TALBOT, A. C., Provincial Land Surveyor for Quebec.
Montmagny, Que.

TALBOT PIERRE CLÉOPHAS, Provincial Land Surveyor for Quebec.
Montmagny, Que.

WEBB, A. C., Member of Board of Examiners for D.L. and D.T.S., Provincial Land Surveyor for Ontario.
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WHITE, GEORGE W. R. MONTAGU, F.R.S.G.S., Civil Engineer.
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WHEELER, ARTHUR O., Provincial Land Surveyor for Ontario and Manitoba, Department of the Interior.
Ottawa, Ont.

ASSOCIATE MEMBERS.

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Geological Survey, Ottawa, Ont.

COSTE, EUGENE M. A., M.E., of the "École Nationale Supérieure des Mines de France, Paris," Mining Engineer to the Geological Survey of Canada.
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Golden, British Columbia.

DOWLING, DONALDSON B., B.A.Sc. (McGill), Field Explorer and Topographer, Geological Survey of Canada.
Geological Survey, Ottawa, Ont.

MCEVOY, JAMES, B.A.SC., Geological Surveyor.
255 Nicholas St., Ottawa, Ont.

MCNUTT, CHARLES, B.A.Sc. (McGill), Mining and Civil Engineer.
Aspin, Colorado, U.S.A.

ODELL, C. M , C.E., Assc. Mem. Can. Soc. Civil Engineers.
Truro, N.S.

RICHARD, LOUIS N., B.A.Sc. (McGill), Draughtsman.
Geological Survey, Ottawa, Ont.

SMITH, WILLIAM H. C., Assc. Mem. Can. Soc. Civil Engineers, Assistant Field Geologist and Explorer, Geological Survey of Canada.
292 Lisgar Street, Ottawa, Ont.

SYMES, P. B., Associate of Applied Science, King's College, London, Eng., Department of the Interior.
326 Lyon Street, Ottawa, Ont.

STEPHEN, ARTHUR, Architect and Engineer.
Collingwood, Ont.

TOPLEY, H. N., Photographer to the Department of the Interior of Canada.
Ottawa, Ont.

WHITE, JAMES, Graduate Royal Military College, Topographer.
Geological Survey, Ottawa, Ont.

NOTE: Should there be an error in the name, standing or address of any gentleman in the foregoing list, the Secretary-Treasurer will be not only happy to correct the same in the next issue, but will be very much obliged for any information that will enable him to do so.

REPORT OF PROCEEDINGS

OF THE

ASSOCIATION OF DOMINION LAND SURVEYORS

AT ITS

SEVENTH ANNUAL MEETING,

HELD AT

OTTAWA, FEBRUARY 18 AND 19, 1890.

PRICE FIFTY CENTS.

Ottawa:
PRINTED FOR THE ASSOCIATION BY A. S. WOODBURN.
1890.

To Dominion Land Surveyors.

SHOULD you not be a member of the Association, it is respectfully urged that you at once become such, and by your earnest co-operation assist in making it a means of elevating the standard of the profession, and, by an interchange of ideas, of increasing the scientific knowledge of its members to as great an extent as possible.

Those who are not Dominion Land Surveyors by profession, but whose pursuits, scientific acquirements or practical experience fit them to co-operate with Dominion Land Surveyors in the advancement of professional knowledge, are qualified to join as Associate Members.

Should you be acquainted with any Dominion Land Surveyor who is not a member, or any gentleman qualified to join as an Associate Member, use your earnest endeavours to make him become such. "IN UNITY IS STRENGTH." Then let us unite together, and as a body be one man with one end in view,

"The Welfare of the Profession."

Any Dominion Land Surveyor may become a member of the Association upon payment of dues.

Application blanks for Associate Membership may be obtained from the Secretary-Treasurer.

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ASSOCIATION OF DOMINION LAND SURVEYORS

Organized April 24th, 1882.

OFFICERS FOR 1890.

HONORARY PRESIDENT.

THE SURVEYOR GENERAL........ ....OTTAWA, ONT.

PRESIDENT.

WILLIAM OGILVIE, D.L.S.................... ....GLOUCESTER, ONT.

VICE-PRESIDENT.

SAMUEL BRAY, D.L.S....... ....OTTAWA, ONT.

SECRETARY-TREASURER.

ARTHUR O. WHEELER, D.L.S.........................OTTAWA, ONT.

EXECUTIVE COMMITTEE.

J. S. DENNIS, D.T.S....................................OTTAWA, ONT.
OTTO J. KLOTZ, D.T.S..............................PRESTON, ONT.
JOHN McLATCHIE, D.L.S......................NEW EDINBURGH, ONT.

AUDITORS.

J. F. SNOW, D.L.S..................... ....OTTAWA, ONT.
F. DRISCOLL, D.L.S...................................AYLMER, QUE.

The Eighth Annual Meeting will be held at Ottawa, the Third Tuesday in February, 1891.

STANDING COMMITTEES

FOR 1890.

GEODETIC AND TOPOGRAPHICAL SURVEYING.

O. J. KLOTZ *(Chairman)*, W. S. DREWEY, J. I. DUFRESNE.

LAND SURVEYING.

JOHN McLATCHIE *(Chairman)*, D. C. MORENCY, J. H. BROWNLEE.

PERMANENT MARKING OF SURVEYS.

J. S. DENNIS *(Chairman)*, S. L. BRABAZON, J E. SIROIS.

NATURAL HISTORY.

PROF. JOHN MACOUN *(Chairman)*, J. F. GARDEN, WM. MURDOCH.

NOTE.—The addresses of the Chairmen of the several Committees may be obtained from the "List of Members." (See Index, page 3.)

CONSTITUTION AND BY-LAWS.

Constitution.

ARTICLE I.

Name of the Association.

"The Association of Dominion Land Surveyors."

ARTICLE II.

Objects of the Association.

The promotion of the general interests and elevation of the standard of the profession.

ARTICLE III.

Members.

1. The Association shall consist of Active Members, Honorary Members and Associate Members.

2. Active Members must be Dominion Land Surveyors, and only such shall hold office.

3. Any Dominion Land Surveyor may become an active member upon payment of the fees prescribed by Article IX.

4. Honorary Members must be nominated by two Active Members, and the nomination approved of by a unanimous vote of the Executive Committee. The nomination with approval must be in the hands of the Secretary-Treasurer at least one month before the Annual

Meeting. Persons nominated for Honorary Membership shall submit a paper to be read at the Annual Meeting. They shall be elected by ballot in the manner hereinafter provided for the election of officers of the Association. The number of Honorary Members shall not at any one time exceed twenty, and they shall be exempt from payment of dues.

5. (*a*) Associate Members shall be those who are not Dominion Land Surveyors by profession, but whose pursuits, scientific acquirements, or practical experience qualify them to co-operate with Dominion Land Surveyors in the advancement of professional knowledge.

(*b*) Provincial Land Surveyors of any Province, and Articled Pupils of Dominion and Provincial Land Surveyors, shall be eligible as Associate Members.

(*c*) Associate Members shall be nominated by one active member in writing to the Secretary-Treasurer, and on approval of such nomination by the Executive Committee shall at once be admitted upon payment of fees prescribed by Article IX.

6. Associate Members shall not vote.

ARTICLE IV.

Officers.

1. The Surveyor General of Dominion Lands shall be Honorary President of the Association.

2. The Officers of the Association shall consist of an Honorary President, a President, Vice-President, Secretary-Treasurer, and an Executive Committee, all of whom, except the Honorary President, shall be declared elected at the Annual General Meeting by letter ballot.

3. No member of the Association shall fill the office of President for more than two consecutive years.

4. Nominations for Officers of the Association shall be made to the Secretary-Treasurer in writing by two Active Members, at least two months before the Annual General Meeting. The Secretary-Treasurer

shall prepare and forward ballot papers to the members of the Association, who shall return them marked in sealed envelopes to the Secretary-Treasurer before the date of the Annual General Meeting.

5. The letter ballots shall be opened at the Annual General Meeting, and the majority of the ballots cast in each case shall decide the election.

6. In case of an even or tie vote, the election shall be decided by the members present at the Annual Meeting voting by ballot.

7. Should the Secretary-Treasurer not receive three nominations for each of the offices of President, Vice-President and Secretary-Treasurer, or six nominations for members of the Executive Committee, the Executive Committee shall add to the ballot papers a sufficient number of names, to make up the number of three candidates for each of the offices and twelve for the Executive Committee.

ARTICLE V.

Meetings.

1. The Annual General Meeting shall commence on the third Tuesday in February, at Ottawa.

2 Special Meetings of the Association may be called by the President, or by the President when requested in writing by three or more members.

3. Eleven members shall form a quorum at any meeting for the transaction of business.

ARTICLE VI.

Amendments

1. Any member of the Association, who may desire a change in the Constitution of the Association, shall give notice of such contemplated change to the Secretary-Treasurer, at least two months before the next Annual General Meeting, and the Secretary-Treasurer shall, in his notice of such meeting to the members, notifiy them of the name of the party proposing such change, and the nature thereof.

2. No by-law or rule shall be altered, or new one adopted, except at a General Meeting, and such amendment shall be voted upon at the said General Meeting, two-thirds majority of the votes cast being necessary for its adoption.

ARTICLE VII.

Executive Committee.

1. The Executive Committee shall consist of the President, Vice-President, Secretary Treasurer, and three members; and shall have the direction and management of the affairs of the Association. Three members to form a quorum.

2. The Meetings of the Executive Committee to be held at the call of the President, or Secretary-Treasurer.

ARTICLE VIII.

Auditors.

Two Auditors, to be elected by ballot, shall audit the accounts of the Association annually, and present their report of the same at the Annual General Meeting.

ARTICLE IX.

Subscriptions.

1. The fee for membership for Active Members shall be five dollars, and an annual subscription of two dollars for each subsequent year; both payable in advance.

2. The fees of Active Members shall be forwarded to the Secretary-Treasurer with the ballot papers for election of Officers, and any ballot unaccompanied by the fees mentioned in sub-clause No. 1 shall not be counted in the Election.

3. Associate Members shall pay a fee of two dollars annually.

4. The names of members twelve months in arrears shall be struck off of the roll.

By-Laws.

ORDER OF BUSINESS.

1.

1. Reading of Minutes of Previous Meeting.
2. Reading of Correspondence and Accounts.
3. Propositions for Honorary Membership.
4. Balloting for Honorary Membership.
5. Reports.
6. Unfinished Business.
7. New Business.
8. Election of Officers.
9. Adjournment.

2. All motions must be in writing, and shall contain the names of the mover and seconder, and must be read by the Chair before being discussed.

3. Reports of Committees must be in writing, signed by the Chairman thereof.

4. No member shall speak on any subject more than once, except the introducer of the subject, who shall be entitled to reply; every member, however, shall have the right to explain himself, subject to the discretion of the Chair.

5. When a motion has been finally put to the meeting by the Chairman, all discussion thereon shall be closed.

6. The Chairman shall appoint two scrutineers when a ballot is taken.

7. Every member while speaking shall address the Chair.

DUTIES OF OFFICERS.

1. The President shall preside at all meetings at which he is present; in his absence the Vice-President; and in the absence of both the meeting shall appoint a Chairman.

2. The presiding officer shall only have a casting vote, not a deliberate one.

3. The Secretary-Treasurer shall keep an accurate record of all meetings, conduct all correspondence, announce all meetings, receive all fees and subscriptions and other moneys, pay no bills unless sanctioned by the Executive Committee and signed by their Chairman, make an annual report of all receipts and disbursements, and shall perform such other duties as may from time to time be assigned him by the Executive Committee

Programme.

TUESDAY, FEB. 18th, 9.30 A.M.

Meeting of Executive, Standing and Entertainment Committees.

Reading of Minutes of previous Meeting.

Reading of Correspondence.

Report of Secretary-Treasurer.

Report of Auditors.

Appointment of Scrutineers of Ballots

TUESDAY, 2 P.M.

Reports of Standing Committees on "Geodetic Surveying" and "Publication."

Questions, etc., submitted to the Association.

PAPER—"Want of Precision in Surveys."
JOHN MCLATCHIE, D.L.S., New Edinburgh, Ottawa, Ont.

PAPER—"Remarks on a trip to Alaska and return, via Mackenzie River."
WM. OGILVIE, D.L.S., Gloucester, Ont.

TUESDAY, 7.30 P.M.

President's Address.

LECTURE—On Astronomy.
W. F. KING, D.T.S., Ottawa, Ont.
Illustrated by Sciopticon Views by H. N. TOPLEY.

PAPER—"Hydrographic Surveying."
Staff Commander. J. G. BOULTON, R.N., Ottawa, Ont.

PAPER—"The Railway Belt in British Columbia."

OTTO J. KLOTZ, D.T.S., Preston, Ont.

REMARKS—On Natural History with Special Reference to Canadian Fish.

Prof. JOHN MACOUN, F.L S.,
Geological Survey of Canada.

WEDNESDAY, FEB. 19th, 9.30 A.M.

Reports of Standing Committees on "Land Surveying," "Permanent Marking of Surveys," "Natural History and Geology" and "Topographical Surveying."

Unfinished Business.

Report of Scrutineers of Ballots.

New Business.

Arrangement of Committees for 1890.

WEDNESDAY, 1.30 P.M.

Meeting of Standing Committees for 1890.

PAPER—"Plans and Field Notes of Surveys of Dominion Lands."

P. B. SYMES, Technical Br. Dept. of Interior.

PAPER—"A Graphic Solution of Spherical Triangles."

W. F. KING, D.T.S., Ottawa, Ont.

LECTURE—"A Practical Chemical Demonstration of the Gelatino Bromide Process."

H. N. TOPLEY, Photographer to the Dept. of Interior.

ADJOURNMENT.

Full discussion after each paper, open to all.

WEDNESDAY EVENING—ANNUAL DINNER.

Minutes.

TUESDAY, February 18th.

Morning Session.

The Annual General Meeting was held in the St. Andrew's Hall.

At 10 a.m. the President, J. S. DENNIS, took the Chair and declared the meeting open.

The President then left the Chair to enable the Executive and other Committees to meet.

On the President resuming the Chair, the Minutes of the preceding Annual Meeting were read and, on motion, adopted.

The Secretary-Treasurer read the following communications :—

Circular from a Committee of the University of Pennsylvania, offering prizes of $400, $200 and $100 for the best three papers on Road Making and Maintenance, and inviting the members of the Association to enter for the competition. Papers to be submitted by April 5th, 1890.

Moved by WM. OGILVIE, seconded by C. A. BIGGER, and *Resolved :—*

That the communication read by the Secretary-Treasurer, entitled "A move for better roads," be received and placed on file, and that the members of the Association be informed of the offers contained therein.

Letter from W. H. C. Smith, of the Geological Survey, stating that he had been unable to prepare his promised paper in time for the meeting, but if permissible, would prepare same for publication in the Annual Report.

Letter from W. H. C. Smith (Associate Member), tendering his resignation. Accepted.

WM. OGILVIE expressed an opinion that Mr. Smith should be given the opportunity of having his paper published in the Annual Report, did he so desire it, the more especially in view of the late friction between the Association and the Geological Survey Staff. C. A. BIGGER agreed with Mr. Ogilvie. The PRESIDENT and SECRETARY-TREASURER thought no action should be taken in the matter.

Moved by WM. OGILVIE, seconded by C. A. BIGGER, and *Resolved* :—

That the offer of W. H. C. Smith, of the Geological Survey Staff, to contribute a paper to the Annual Report of the Association for 1890, be received, and that the Secretary-Treasurer be instructed to acknowledge the same and allow him to exercise his own pleasure in the matter.

Letter from J. White (Associate Member), of Geological Survey, tendering his resignation. Accepted.

The Secretary-Treasurer presented his Report accompanied by a statement of Receipts and Expenditures. Received and laid over for report by auditors.

Moved by WM. OGILVIE, seconded by J. F. SNOW and *Resolved* :—

That John McLatchie, J. E. Sirois and J. J. McArthur do act as scrutineers of ballots for the Election of Officers for the year 1890.

Auditors' Report received and together with Secretary-Treasurer's Report adopted.

Afternoon Session.

The meeting opened at 2 p.m., the President in the Chair.

The Report of the Committee on Geodetic Surveying was presented by its Chairman, OTTO J. KLOTZ. Received and adopted.

This Committee also reported upon two Problems, submitted to the Association by S. L. BRABAZON, D.L.S., and furnished solutions for the same. Received and adopted.

A question relating to the insertion of the words "more or less," in a description for deed or patent, was submitted by A. O. WHEELER.

Moved by W. S. DREWRY, seconded by WM. OGILVIE, and *Resolved* :—

That the question submitted by Mr. Wheeler *re* the words "more or less" to be inserted in the description for a deed or patent, be referred to the Committee on Land Surveying, for report thereon during the present meeting.

The Report of the Committee on Publication was, in the absence of its Chairman, presented by J. A. BELLEAU.

The reading of this report raised the question of printing the Constitution and By-Laws yearly in the Annual Report. After discussion it was

Moved by O. J. KLOTZ, seconded by J. F. SNOW and *Resolved* :—

That the Report of the Committee be adopted, and the matter of Constitution and By-Laws be left to the Committee on Publication for the year 1890.

The PRESIDENT brought forward the matter of Railway Right of Way Surveys through Dominion Lands, and stated briefly the action taken so far by the Association. He referred to the Memorial, and Letter accompanying the same, prepared in 1886 by a Special Committee, and forwarded to the Minister of the Interior, both of which were published in the Fourth Annual Report ; also to the President's Address as published in the Fifth Annual Report ; and read the reply received from the Deputy Minister of the Department of the Interior to the above-mentioned Memorial, stating that "So far as this Department is concerned there is nothing in the fact that a licensed surveyor has not made the surveys of a right of way, and certified the maps or plans, to prevent the lands included in a Crown grant being properly described with reference to such right of way.

Mr. Dennis pointed out that in the Railway Act, section 134, it was distinctly stated that the Railway Company *must* file with the Registrar, within six months, a plan of the Right of Way Survey ; and further that the Territories Real Property Act necessitated any survey so registered being made, and the plan thereof being signed by a Dominion Land Surveyor. It was not discretional with the Registrar, as the Railway Act distinctly stated the course to be pursued.

The matter had again been brought before the Association.

He had received a letter from one of its members in the North-West Territories, enclosing the opinion of an eminent lawyer to the effect that such surveys could, legally, only be made by Dominion Land Surveyors.

The member who had submitted the above opinion suggested that a branch should be formed in the North-West Territories to work with the Association, and that the said branch should take this matter in hand.

After discussion it was moved by OTTO J. KLOTZ, seconded by WM. OGILVIE, and *Resolved* :—

That the question of Right of Way Surveys in the North-West Territories be referred to the Executive Committee of 1890 with full powers to act.

A Paper "Want of Precision in Surveys," was read by John McLatchie and followed by discussion.

A Paper "Remarks on a trip to Alaska and return via Mackenzie River," was read by Wm. Ogilvie.

Evening Session.

The meeting opened at 8 p.m., the President in the Chair.

The President read his Annual Address.

PRESIDENT'S ADDRESS.

To the Members of the Association of Dominion Land Surveyors.

Gentlemen,

I have very much pleasure in welcoming you to this, the seventh annual meeting of the Association, and the pleasure is strengthened when I note the large attendance of members and the apparent intention on the part of all to contribute in making the meeting a success.

Before speaking to you of the programme to be followed out during our session, I wish to refer briefly to the work accomplished by the Association up to date, and more particularly to the results of the past year during which I have had the honour to be your President.

It is needless for me to speak of the history of our Association, that subject was very fully treated of by the President in his address last year. I wish, however, to bring before you some of the practical results which have accrued to us as a profession from the formation of this Association, with the hope that our members, realizing these benefits, will work heartily in promoting its continued success.

You have heard the report of our zealous and hard working Secretary-Treasurer, and have I feel sure been gratified with the favourable showing both as regards our financial position and our membership; it is not, therefore, necessary for me to say anything further on those heads.

The first matter to which I wish to draw your attention is that of our Annual Reports. These Reports have grown, from very small beginnings, to a volume during the past year, of which any professional society might well feel proud. The subject matter of our reports during the last two or three years cannot but have been of great interest and value to our members, covering as it has many branches of professional knowledge, and affording food for thought and study on the part of all.

Through the exchange of our Reports we have been able to provide our members with the Reports of a number of sister Societies, and thus keep them in touch with fellow workers in all branches of our Profession. In a Society such as ours, which has for its object the advancement of the knowledge of its members, the yearly

Report should contain all subjects which are likely to induce inquiry and study, and in this direction I think our Annual Report is doing a good work; this is evidenced by its increasing size and the range of subjects discussed. Our Report of last year has received very favourable notice at the hands of many of the leading newspapers, and the Association has been complimented on the work it is doing.

To speak more particularly of the work of the Association during the past year I beg respectfully, on behalf of the Executive Committee, to state as follows :—

Six meetings of the Executive Committee have been held, at which all matters of interest to the Association have been discussed and, in as far as possible, dealt with. Among these I may mention the following :—

SURVEYS OF INDIAN RESERVES IN BRITISH COLUMBIA.

Shortly after our last Annual Meeting the attention of the Committee was drawn to the fact that certain gentlemen who were being, or had been, employed by the Government in surveying Indian Reserves in the Railway Belt of British Columbia, were not Dominion Land Surveyors. On behalf of the Association, I opened a correspondence with the Hon. the Minister of the Interior and Superintendent General of Indian Affairs, on this subject. Several communications have passed between us on the matter, and I have now very much pleasure in announcing that the Deputy Minister of Justice, to whom the matter was referred, has decided that all surveys of Indian Reserves, which have been made in the Railway Belt since it became Dominion Lands, should have been performed by Dominion Land Surveyors. This decision will, I am sure, be as gratifying to the members as it was to the Committee. The correspondence on this subject is in the hands of the Secretary-Treasurer, for perusal by any of the members who desire to see it.

GEOGRAPHICAL NOMENCLATURE.

This subject was, as you are aware, taken up at the Fifth Annual Meeting of the Association. Its importance justified the attention then paid it, both by the Committee, and those gentlemen who so kindly assisted in bringing it to the notice of the proper authorities, and it is very gratifying to note that our efforts have received recognition, and that the steps necessary to put our suggestions in working shape are being taken. This question is one that should interest all surveyors, for they are more directly concerned in the naming of geographical features, than any other class in the country, and any steps having in view the adoption of uniform rules for their guidance should receive hearty support. In this connection attention is drawn to the valuable paper on this subject by A. T. Drummond, Esq , to whom the Association are indebted for much kind interest ; and it is suggested that the Secretary-Treasurer be instructed to forward a copy of this paper to the Minister of the Interior.

AFFILIATION OF THE DIFFERENT ASSOCIATIONS OF LAND SURVEYORS.

During the past summer it suggested itself to me that the interests of the Profession throughout the Dominion would be strengthened by the affiliation of all the

Associations of Land Surveyors. With this in view I submitted a scheme for the accomplishment of this end to the Executive Committee. The scheme was as follows :—

"At the present time there are four Associations of Land Surveyors in Canada, viz : the Provincial Associations of the Provinces of Quebec, Ontario and Manitoba, and the Association of Dominion Land Surveyors.

Of these, two Associations, those in Quebec and Manitoba, are incorporated Societies, having power to control the examinations for admission to the Profession, and generally to administer matters relating to surveying. The other two Associations are simply Societies governed by a constitution and by-laws, and have in view the advancement of professional knowledge and feeling, by holding annual meetings, and publishing an annual report.

It has suggested itself to the undersigned that the general welfare of all the Associations would be materially advanced by the adoption of a system of affiliation somewhat as follows :—

1. That one joint annual meeting of all the Associations should be held, instead of each Association holding its own meeting as at present, and that this joint meeting be called the Annual Convention of Canadian Land Surveyors.
2. That the Annual Convention be held alternately at points in the different Provinces, most central for the members of the Association of that Province
3. That each Association maintain its own individuality and issue its own annual report, containing papers contributed by its members, as at present, the report of each Association containing only a short account of the proceedings of the Annual Convention.
4. That the Annual Convention be conducted as follows :—

(*a*) The Meeting to extend over two days, being ended by an annual dinner or some other social gathering.

(*b*) A certain portion of the first day to be allotted to each Association for the transaction of its individual business, appointments of committees, etc., or these sub-meetings might go on at the same time, as is the practice with the different sections of the Royal Society. The first evening and the second day (except the evening which is to be devoted to the social event above mentioned) to be spent in the reading and discussion of such papers, from among all those submitted to the different associations, as may be selected by a committee composed of the Presidents, Secretary-Treasurers and two elected members of each Association.

(*c*) The joint annual convention to be presided over by the Presidents of the different Associations in turn.

If the aforementioned scheme meets with the approval of the different Associations arrangements for carrying it into effect could be made by the appointment of the President and two other members at their next Annual Meeting of the Associations, who would act with a like committee from each of the other Associations in drawing up the necessary and defined scheme of rules, etc. to give effect to the above; this joint committee could meet at some point mutually agreed upon.

It is evident that if a joint convention of all the Associations was held the attendance would be large enough to insure success in every way. Cheap railway fares could be obtained, and the holding of some social entertainment in connection with the meeting would be an inducement for members to bring their friends and families with them. The large attendance would make it an object for the city in which the convention was held to extend its hospitalities to the members. And there is no question that any action taken by all the Associations at a joint convention would carry very much more weight than the individual actions or representations of Associations now do.

Again, the bringing together of Surveyors from all the Provinces cannot but result in mutual benefit in many ways, and the undersigned feels confident that if the proposed scheme is carried into effect the results will be an increased interest in our Profession not only by its numbers but by the press and public generally."

With the consent of the Executive Committee a copy of the foregoing, with the following letter, was sent to each of our sister Associations :—

"The Executive Committee of this Assocation have had under consideration a scheme for the affiliation of the different Associations of Land Surveyors in the Dominion, which has been submitted by Mr. J. S. Dennis.

The outlines of the proposed scheme are set forth in the copy of the memorandum relating thereto which is enclosed herewith.

At the last meeting of the Executive Committee it was resolved that the proposed scheme should be submitted to the Executive Committees of the different Associations so that their views regarding the possibility of carrying the proposed scheme into effect might be obtained.

In submitting this scheme I am directed to say that our Executive are unanimous in thinking that the welfare of all the Associations would be very materially advanced were some scheme of affiliation agreed upon.

The scheme submitted is of course a mere outline, and would have to be elaborated by a committee composed of representatives of all the Associations.

The object in submitting this scheme is to obtain from the Executive Committees of all the Associations their views on the subject, so that if the scheme receives favorable consideration the necessary further steps may be taken to have the matter dealt with by the different Associations.

Will you kindly submit this to your Executive Committee as soon as possible, and acquaint us with their views thereon."

The object of sending this was if possible to obtain from the different Associations an expression of opinion on the subject, so that we might be able to lay it before you for discussson and action. So far we have heard only from the Manitoba Association, and their reply is. I regret to say, unfavorable. However, the scheme is now before you for discussion, and such further action as may be deemed necessary.

I cannot leave this subject without saying that personally I feel very strongly that could some scheme of affiliation be successfully carried out, not only the different Associations but the Profession as a whole would benefit largely.

THE SURVEY OF RIGHTS OF WAY FOR RAILWAY PURPOSES.

This subject received considerable attention at the hands of the Association in 1887, however, our efforts at that time failed in getting a decision in accordance with our views. The subject has lately come home to some of our members in the North-West Territories, and has come before the Executive Committee; owing, however to press of other matters we have been unable to move regarding it. It is respectfully suggested that the incoming Committee take the matter in hand, and see whether anything can be done to protect what we consider the rights of our Profession.

TRIGONOMETRICAL SURVEY OF THE DOMINION.

The Committee are unable to report anything further than has been noticed in the last Annual Report regarding this much to be desired work. There is no doubt the subject has received much attention at the hands of the proper authorities, but it is a work requiring careful thought and consideration before being undertaken, and the probable large cost of carrying it out no doubt delays its initiation. However, we know the importance of the work and realize that it is only a question of time until our progressive country will follow in the footsteps of other countries in carrying out this national undertaking.

NATURAL HISTORY.

I beg to call the attention of our members to the debt we owe Professor Macoun for his great kindness in reference to the above subject. He has gone to great trouble, and much personal inconvenience in bringing this subject to our notice and we owe it to him to do anything we can to carry out his wishes regarding the collection of specimens.

In this connection, and more particularly in regard to the paper read by Mr. Drummond at our last meeting, entitled "Suggestions for Surveyors Reports" I would refer you to a Botanical Catalogue prepared by Professor Macoun with the aid of which surveyors will be enabled to name the different species of trees and plants met with, and it is suggested that the Committee take steps to try and secure copies of this catalogue for our members.

IRRIGATION IN THE NORTH-WEST TERRITORIES.

Among the many valuable papers read at our last annual meeting was that by Mr. Pearce on "Settlement and Irrigation in the North-West Territories." The Committee desire to interest the members of the Association as far as possible in this important subject, not only on account of its importance in relation to the future welfare of the Territories from an Agricultural standpoint, but also on account of the benefit which is sure to accrue to the Profession were a scheme of development on the lines suggested by Mr. Pearce, undertaken.

The subject of Irrigation is receiving considerable attention at the hands of the press in the Territories, and the matter has also been discussed at some length in the Legislative Assembly. In bringing about this result, which is but the forerunner of some action in the matter, Mr. Pearce's paper has played an important part and has been extensively quoted. This is one more important subject brought to public notice through the medium of our Annual Reports.

REPORTS OF STANDING COMMITTEES.

The Executive Committee have referred the following matters to the proper committees, for reports at this meeting :—

1. The problem by Mr. Irwin "Subdivision of a Quadrilateral Figure," to the Committee on Land Surveying.
2. The problems submitted by Mr. Brabazon at last annual meeting, to the Committee on Geodetic Surveying.
3. The paper by Mr. Kirk, "A standard of Precision," to the Committee on Land Surveying.
4. The paper by Mr. Brabazon, "Azimuth by two Stars," to the Committee on Geodetic Surveying.
5. The paper by Mr. Drummond, "Suggestions for Surveyors Reports" to the Committee on Natural History and Geology.

ANNUAL DINNER.

The Committee are of opinion that the pleasure and interest in our annual meetings will be very much strengthened by holding an annual dinner ; surveyors as a rule do not get an excess of the social enjoyments of this life, being, as they frequently are, for long periods away from civilization ; having this in mind, and also the old, but true saying, that "All work and no play makes Jack a dull boy," we have undertaken a dinner in connection with this meeting, and have received every encouragement from the members, and trust that all will contribute in making it a success. We hope to have the pleasure of having most of our honorary members with us and trust that this social gathering together of our members will strengthen the interest in the Association.

T is address was intended to be brief but I am afraid it has extended to almost wearisome length, however my desire to bring before you all subjects of information and interest must be my excuse for detaining you so long.

In closing I desire to express my thanks to the members for the honor done me in making me your President during the past year, and I also wish to convey to the members of the Executive Committee my appreciation of their readiness at all times to assist in furthering the welfare of the Association, which should be the constant aim of all.

In conclusion, I beg to call your attention to the very instructing programme of papers to be read during the meeting, and I bespeak for them the attention which their importance deserves.

I would also say that it is hoped that full and free discussions will follow the reading of each paper, for by this means members will add to the interest of the proceedings and evidence their desire to make the meeting a success.

Respectfully submitted,

J. S. DENNIS,

OTTAWA, February 18th, 1890. *President.*

Moved by OTTO J. KLOTZ, seconded by JOHN McLATCHIE and *Resolved*:—

That the President's Address be received.

A PAPER, "Hydrographic Surveying," was read by Staff Commander J. G. BOULTON.

Moved by OTTO J. KLOTZ, seconded by WM. CRAWFORD and *Resolved*:—

That a vote of thanks be tendered Commander Boulton for his interesting and instructive paper on Hydrographic Surveying.

A PAPER, "Railway Belt in British Columbia," was read by OTTO J. KLOTZ.

A LECTURE on Astronomy was delivered by W. F. KING and illustrated by Sciopticon views by H. N. TOPLEY.

A LECTURE on the Gelatino Bromide process was delivered by H. N. TOPLEY.

WEDNESDAY, February 19th.

Morning Session.

The meeting opened at 10 a.m., the President in the Chair.

The Report of the Committee on Topograhical Surveying was submitted by its Chairman, W. S. DREWRY.

Moved by WM. CRAWFORD, seconded by J. F. SNOW, and *Resolved*:—

That the Report be received and adopted.

Moved by WM. CRAWFORD, seconded by A. O. WHEELER, and *Resolved*:—

1. That it would be of great benefit to the Profession, and the Public generally, were the work of E. Deville Esq., Surveyor General, on Photo-Topography published, and thus placed within the reach of professional men.

2. That this resolution be transmitted to the Surveyor General, and the hope expressed that he may find it possible to have steps taken to carry out such publication.

The PRESIDENT drew the attention of the members to the exhibit of Surveyors and Draughtmen's instruments and supplies made by Messrs. Hope & Co., of Ottawa, and referred to the interest taken by Mr. Hope in the Association and the Profession.

The PRESIDENT also referred to the encouragement and assistance given to the Association by the Grand Trunk Railway in the shape of a yearly advertisement in the Annual Report, and hoped that the members would, when travelling, give that Road the preference.

The Secretary-Treasurer read the Report of the Committee on Permanent Marking of Surveys as published in the Sixth Annual Preceedings of the Association, the said Report not having been presented at the Sixth Aunual Meeting.

Moved by WM. OGILVIE, seconded by J. F. SNOW and *Resolved* :—

That the Report of the Committee be received, and be referred to the Committee on Permanent Marking of Surveys for the ensuing year, for action thereon.

The Report of the Committee on Natural History and Geology was presented by its Chairman, PROF. MACOUN.

Moved by WM. OGILVIE, seconded by WM. CRAWFORD and *Resolved* :—

That the Report be received and adopted,

Moved by J. J. MCARTHUR, seconded by WM. CRAWFORD, and *Resolved* :—

That the in coming Executive Committee take steps to secure a sufficient number of Professor Macoun's Botanical Catalogues to distribute among the Members and Associate Members of the Association.

The Report of the Committee on Land Surveying was presented by its Chairman, JOHN MCLATCHIE.

Moved by J. E. SEROIS, seconded by WM. CRAWFORD, and *Resolved* :—

That the Report be received and adopted.

The PRESIDENT finding it necessary to leave the hall on business, the Chair was taken by the Vice-President.

The Committee on Land Surveying submitted a report on the question relating to the use of thewords "more or less" in a description, and after discussion it was

Moved by J. F. SNOW, seconded by THOS. BREENE, and *Resolved*:—

That the Report of the Committee be received and adopted.

The Report of the Scrutineers of Ballots showed the following Officers to be elected for the ensuing year:

President	Wm. Ogilvie.
Vice-President	Samuel Bray,
Secretary-Treasurer	A. O. Wheeler,
Executive Committee	J. S. Dennis, Otto J. Klotz, John McLatchie,
Auditors	J. F. Snow, F. Driscoll,

Moved by Wm. Crawford, seconded by J. F. Snow, and *Resolved* :—

That the Report of the Scrutineers be received and adopted.

Afternoon Session.

The Meeting opened at 2 p.m., the President in the Chair.

The President's Address was brought up for discussion.

Regarding affiliation of the several Surveyors' Associations in Canada, it was

Moved by W. S. Drewry, seconded by A. O. Wheeler, and *Resolved* :—

That Wm. Ogilvie, O. J. Klotz and John McAree be appointed a Committee of this Association to act at the coming Session of the Association of Provincial Land Surveyors of Ontario in completing the necessary arragements to bring about a scheme of affiliation ; and that they are hereby empowered to enter into an agreement for affiliation on the lines suggested by Mr. Dennis in his memorandum on this subject. The Committee to report to the Executive Committee.

Mr. Drewry explained that his reason for naming the gentlemen mentioned in the above motion was that they would in all probability be present at the Annual Meeting of the Ontario Association and would therefore be competent to take action in the matter.

Moved by John McLatchie, seconed by J. E. Sirois, and *Resolved* :—

That the President's Address be adopted.

Moved by Otto J. Klotz, seconded by W. S. Drewry, and *Resolved* :—

That a hearty vote of thanks be accorded to our indefatigable Secretary-Treasurer, and furthermore that the sum of thirty dollars be paid him as a slight recognition of his valuable services.

Moved by JOHN MCLATCHIE, seconded by D. C. MORENCY, and *Resolved* :—

That the Executive Committee be authorized to strike the Standing Committees for 1890; also to arrange list of Exchanges for current year.

A PAPER, "Plans and Field-Notes of Surveys of Dominion Lands," was read by P. B. Symes and discussed.

A PAPER, "Graphic Solution of Spherical Triangles," was read by W. F. King and illustrated by diagrams on the black-board.

Remarks by Professor Macoun on Natural History, with special reference to Canadian Fish, gave rise to a good deal of discussion (see synopsis under LECTURES.)

Moved by JOHN MCLATCHIE, seconded by WM. CRAWFORD, and *Resolved* :—

That this meeting do now adjourn until the third Tuesday in February, 1891.

NAMES OF MEMBERS PRESENT.

Honorary Members :

Bell, Robert, M.D., LL.D., Assistant Director of the Geological Survey of Canada.

Boulton, J. G., Staff Commander, R.N.

King, W. F., D.T.S., Chief Astronomer to the Department of the Interior of Canada.

Macoun, John, F.L.S., Botanist and Naturalist to the Department of the Interior of Canada.

Active Members :

Belleau, J. A.
Bigger, C. A.
Brabazon, A. J.
Bray, Samuel.
Breene, Thos.
Cozens, Joseph.
Crawford, Wm.
Dennis, J. S.
Drewry, W. S.
Dumais, P. T. C.
Green, T. D.
Klotz, Otto J.
Morency, D. C.
Mountain, G. A.
McArthur, J. J.
McLatchie, John.
Nelson, J. C.
Ogilvie, Wm.
Rauscher, R.
Sirois, J. E.
Snow, J. F.
Vicars, John.
Webb, A. C.
Wheeler, A. O.

Associate Members :

Dowling, D. B.
McEvoy, Jas.
Smith, Jacob.
Symes, P. B.

Visitors.

Rev. W. Murphy, O.M.I., B.A.	University of Ottawa.
L. A. Hamilton, Land Commissioner	Canadian Pacific Ry. Co.
Col. Anderson	Marine Dept., Ottawa.
R. Sinclair	Dept. Indian Affairs, Ottawa.
P. M. Barker, Inspector of Registry Offices,	North West Territories.
J. L. Coté, D.L.S.	
J. A. Burrows	Winnipeg.
Horrace Snow	Winnipeg.
Martin Brady	Surveys Branch, Dpt. Interior
J. Macara	" " "
W. McGreevy	University of Ottawa.
A. Dufresne	" "
A. McDougall	" "
J. L. Laferriere	" "
J. Coté	" "
N. McKenzie	Ottawa.
H. G. Wheeler	Ottawa.
Horrace Lepierre.	

NEW MEMBERS.

Active.

Dickson, H. G.	Selkirk, Man.
Dufresne, L. A	Montreal, Que.
Jephson, R. J.	Portage La Prairie, Man.
Reid, J. L	Port Hope, Ont.
Thompson, W. T.	Qu'Appelle Station, Assa, N.W.T.

Associate.

Clayton, Frank	Ottawa, Ont.
Hébert, E. A.	Nicolet, Que.
Smith, Jacob	Banff, Alberta, N. W. T.

Reports.

REPORT OF SECRETARY-TREASURER.

OTTAWA, February 17th, 1890.

TO THE PRESIDENT AND MEMBERS OF THE ASSOCIATION OF DOMINION LAND SURVEYORS.

GENTLEMEN,—

I beg to report as follows for the past Association Year extending from February 16th 1889 to February 17th 1890 (inclusive).

Exchanges were effected with the following societies :—Michigan, Ohio, Illinois, Indiana, Arkansas, Connecticut and Iowa, and copies of the Reports of Proceedings of each Society, with the exception of two, were distributed amongst our members. The two exceptions referred to were, the Indiana Reports which failed to issue, and the Ohio Reports received only a short time ago. They will be distributed as soon as possible.

One thousand copies of the Sixth Annual Report were printed, of which number thirty-five are still on hand. The remainder have been distributed to our members, to our exchanges and to the public, while some few have been sold.

The following gentlemen have become members since the publication of the last list in the Sixth Annual Report :—

H. G. Dickson, of Selkirk, Man. ; L. A. Dufresne, of Dufresne Mills ; R. J. Jephson, of Milwood, Man., and W. T. Thompson, of Qu'Appelle, N.W.T. The Executive Committee have admitted E. A. Hébert and J. Smith to Associate Membership.

In response to the application of the Association, the Minister of the Interior has kindly furnished as complete a set as possible of Geological Survey Reports and Maps as a contribution to the library of the Association.

Up to the 18th inst., 317 letters have been received and 571 letters have been written.

I beg further to submit herewith a statement of Receipts and Expenditures for the past Association Year, and would like to draw your attention to one or two comparisons before leaving the same in your hands, viz :—

By sale of 5th Annual Reports, $2.52 ; by sale of 6th Annual Reports, $5.40 ; by advertisements in 5th Annual Report, $39.00 ; by abvertisements in 6th Annual Report, $63.00, and $12.00 still outstanding ; by dues received during year ending February 1889, $297.00 ; by dues received during year ending February 1890, $215.00.

The falling off in the last mentioned source is chiefly due to the smaller number of new members.

In conclusion, I may say that the present membership of the Association is 99 all told, as follows : —Eleven honorary, seventy-four active, and fourteen associate members.

Trusting, gentlemen, that we may soon attain to the hundreds,

I have the honor to be,

Your obedient servant,

ARTHUR O. WHEELER,

Sec.-Treasurer.

RECEIPTS AND EXPENDITURES

For the Year Extending from February 16th, 1889, to February 17th, 1890 (incl.).

Receipts.

By Balance on hand	$277 69	
" Sale of Annual Reports	5 40	
" Refund of pre-paid duty on Exchanges, 1888	1 75	
" Advts. in Fifth Annual Report	3 00	
" " Sixth " "	63 00	
" dues for 1885	2 00	
" " 1886	2 00	
" " 1887	3 00	
" " 1888	20 00	
" " 1889	94 00	
" " 1890	93 00	
" " 1891	1 00	
		$565 84

Expenditures.

To Rent of Hall for Annual Meeting	25 00	
" Vote to Sec.-Treasurer	50 00	
" Lithographing for 6th Annual Report	30 00	
" R. Dunlop for services	3 00	
" Shorthand writer, 6th Annual Meeting	15 00	
" World Type Writer	10 00	
" R. Hunter, type-writing	2 50	
" Joseph Edwards, taxidermist	3 00	
" Printing and Publishing 6th Annual Report by J. Lovell & Son	262 80	
" Discount on American Silver	15	
" Stationery and Printing	82 50	
" Freight and Expressage	19 36	
" Cab hire and cartage	7 25	
" Duty on Electros for Advts	45	
" Postage	29 48	
		$540 49
Balance on Hand		$ 25 35

Amounts Unable to be Collected.

By arrears of dues	$10 00	
" National Manufacturing Co., 160 Sparks Street, Ottawa, advertisement in 6th Annual Report of the Association	5 00	
		$15 00

Note :—Referring to the last item it may be stated, that although the National M'f'g Co. have used the pages of our Report as an advertising medium, it has been found impossible to obtain payment for the same.

REPORT OF AUDITORS.

OTTAWA, Feb. 18th, 1890.

TO THE PRESIDENT AND MEMBERS OF THE ASSOCIATION OF DOMINION LAND SURVEYORS.

GENTLEMEN,—

We, the undersigned auditors, have examined the accounts of the Association, and find them correct.

There is a balance to the credit of the Association of $25.35.

There are no outstanding liabilities.

Mr. Wheeler deserves the thanks of the Association for the methodical manner in which he has kept the accounts.

W. S. DREWRY,
J. J. McArthur,

REPORT OF COMMITTEE ON GEODETIC SURVEYING.

TO THE PRESIDENT AND MEMBERS OF THE ASSOCIATION OF DOMINION LAND SURVEYORS.

GENTLEMEN,—

Although no active steps have as yet been taken by the Government for a Geodetic Survey, yet it is gratifying to find that the public is becoming alive to the necessity of obtaining some of the practical results that would flow from a geodetic survey, as outlined in the comprehensive memorandum prepared by the committee in 1888.

Quite recently an influential deputation from Montreal waited upon the Government and urged the necessity, in the interests of commerce and shipping, of having an accurate hydrographic survey made of the Gulf of St. Lawrence, as also tidal observations taken. We believe that the deputation directed the attention of the Minister of Marine and Fisheries especially to their request, presuming that such work belonged properly to that department.

It is to be hoped that if the Government favorably entertains the survey of the Gulf of St. Lawrence, that the work will be laid down on such broad lines as to be included within a matured scheme of triangulation, to include, in the meantime, the older Provinces.

It may not be out of place to state that the Department of the Interior is, of all the departments, the best suited for carrying out the primary triangulation, for that department has more to deal with the geography of the country than all the others, and, besides, is provided with the necessary astronomic instruments for such work, and has men who have been engaged in geodetic work. The latter department has begun a triangulation of the Rocky Mountains as a basis for orientation of the photographic surveying that is being carried on there.

Little by little geodetic work is being done here and there, but what is so sadly lacking is the bond of union, a harmony, an interdependence, a scheme for that net of triangles to unite all parts of Canada, and last but not least, an appropriation—though it be small—to begin the primary triangulation.

QUESTIONS REFERRED TO THE COMMITTEE.

Problem.

The following problem submitted by S. L. Brabazon, at the last Annual Meeting, has been referred to the Committee on Geodetic Surveying :—" Suppose a triangulation of part of the St. Lawrence, where the course is easterly and westerly, triangles say three or four miles in average length of side, initial and terminal points say 150 miles apart ; how would you obtain from such a triangulation the difference of latitude and longitude between the first and last stations ? Having regard in a spherical solution, to use that sphere most nearly coincident in curvature with the terrestrial surface involved in the case. Deduce formulæ for working, and illustrate by rough diagram or projection."

This is a problem which is solved in various text books and other publications, and hence it is deemed unnecessary to encumber the Proceedings with a solution.

If, however, there are members of the Association who have not access to any of the publications alluded to, the following, with consent of the Association for publication, may be given. It is the solution as given in Appendix No. 19, 1875, Coast & Geodetic Survey.

" When we know the geographical co-ordinates of latitude and longitude of a point on the earth's surface, and the distance and azimuth to another point, we may treat the problem of computing the latitude and longitude of the second point, and the reverse azimuth in two different ways.—We may either solve the spheroidal triangle formed by the two points and the pole as a whole, arriving at trigonometrical functions of the sought co-latitude, azimuth, and difference of longitude, or we may seek expressions for the differences of the sought, from the given data.

The former or direct method has the inconvenience of requiring the use of ten places of decimals in the computation, in order to give the positions with a degree of exactness corresponding to that of the known distance between the two points, while the second leads to very convenient expressions, on account of the smallness of the differential arcs in most cases of triangulation.

When, however, the arc between the two points reaches several degrees in length, the direct method must be resorted to. This solution has been very completely and elegantly performed by Bessel, and is given in *Astronomische Nachrichten*, No. 86, 1826.

Adopting the second method, we follow in the main Puissant, in the development of the difference of latitude of two points on the spheroid in terms of the distance, azimuth, and latitude of the given point. It will be convenient first to recall the expressions of several lines of an ellipse in terms involving the latitude, L, which is the angle that the normal to any point on the ellipse makes with the major axis.

Designating the major or equatorial semi-axis by a, the minor or polar semi-axis by b, then the *ellipticity* or ratio of their difference to the former is :—

$$\varepsilon = \frac{a-b}{a}$$

The eccentricity e is expressed by

$$e^2 = \frac{a^2-b^2}{a^2}$$

being shown in Fig. 1 by CF, the distance from the centre to the focus ; the normal

$$nl = \frac{a\ (1-e^2)}{(1-e^2\ Sin^2\ L)^{\frac{1}{2}}}$$

The normal nm produced to the minor axis

$$N = \frac{a}{(1-e^2\ Sin^2\ L)^{\frac{1}{2}}}$$

the abscissa $cd = no = N \cos L$

FIG. 1

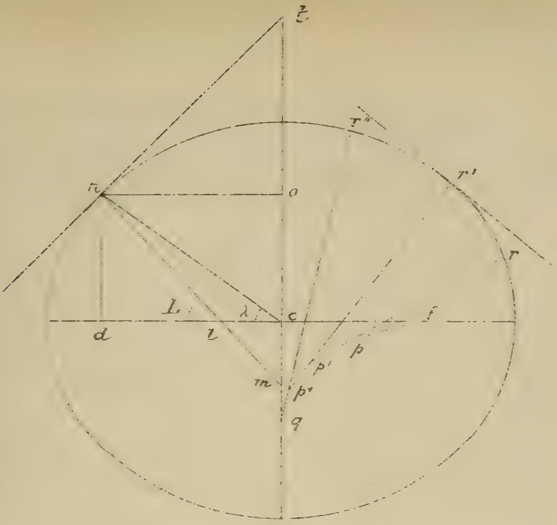
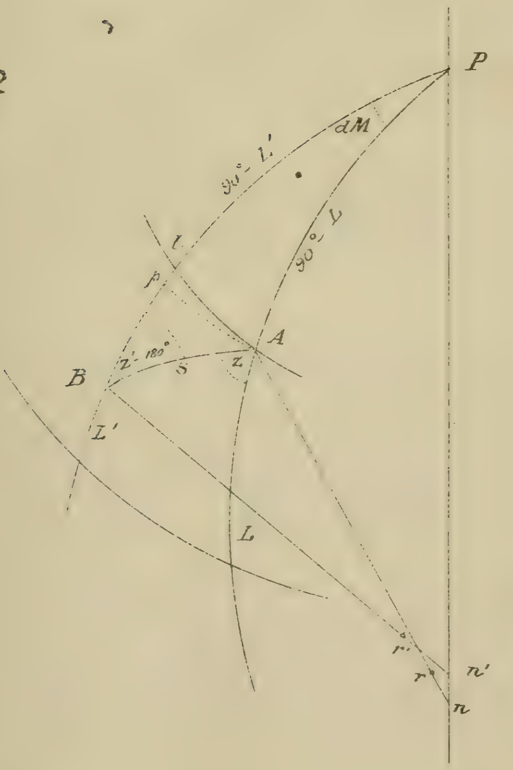


FIG. 2



this is the radius of a parallel on the spheroid. The tangent nt ending at the minor axis $= N \cot L$. The ordinate

$$nd = \frac{a\,(1 - e^2)\, Sin\ L}{(1 - e^2\ Sin^2\ L)^{\frac{1}{2}}}$$

The reduced or geocentric latitude being λ, we have

$$\tan \lambda = \frac{b^2}{a^2} \tan L$$

The radius vector $\rho = a\,(1 - e^2\ Sin^2\ \lambda)^{\frac{1}{2}}$

The radius of curvature rp, $r'p'$, $r''p''$, at any point in the ellipse is

$$R = \frac{a\ (1 - e^2)}{(1 - e^2\ Sin^2\ L)^{\frac{3}{2}}}$$

The terminal points F, p', p'', q form an evolute; at the equator where $Sin\ L = o$ $R = \dfrac{b^2}{a}$ and the centre of curvature is in the focus; at the pole, where $Sin\ L = 1$, $R = \dfrac{a^2}{b}$

The radius of curvature, R, and the normal, N, are the principal functions used in geodesy. It will be observed that radii of curvature for different latitudes do not intersect unless produced, and that when they lie in different meridian planes on the spheroid they will not intersect at all.

A, B, in Fig. 2 are two points on a spheroid of revolution, having the latitudes L, L', and joined by the geodetic line $A\,B = s$, making the angles with the meridian, $PAB = 180° - Z$, $PBA = Z' - 180°$. The azimuths, Z, are reckoned from south around by west in consequence of the latitudes being reckoned from the equator toward the poles, by settled custom, without which the meridional co-ordinate of a point would be more properly measured from the pole, and the azimuth of a line reckoned from the north.

The angle APB, between the two meridional planes passing through A and B, is the difference of their longitudes, M, M', which being reckoned positive to the westward, we have $M' - M = dM$.

Furthermore, An, Bn', Ar, Br', indicate the normals N, N', and the radii of curvature in the meridian, R, R' at the points A and B.

This being premised, and the latitude L of the point A being given, as well as the length K of the geodesic line AB, and its azimuth Z, we propose to find the latitude L' of the point B, the angle dM, and the reverse azimuth Z', by solving the geodetic triangle ABP. Writing λ, λ', for the co-latitudes, ξ for 180°$-Z$, and s for the arc AB, referred to radius$=1$, we have, in a spherical triangle, for λ' the following equation :—

$$\cos \lambda' = \operatorname{Cos} \lambda \operatorname{Cos} s + \operatorname{Sin} \lambda \operatorname{Sin} s \operatorname{Cos} \xi$$

Observing now that s is always a small arc, rarely exceeding 1°, and generally less than 30′, we can develop the increment of λ with reference to that of s in a rapidly converging series, and will have, by Taylor's theorem

$$\lambda' = \lambda + \frac{d\lambda}{ds} s + \frac{1}{2} \frac{d^2\lambda}{ds^2} s^2 + \frac{1}{6} \frac{d^3\lambda}{ds^3} s^3 + \text{------} \qquad (a)$$

In order to determine the differential co-efficients, we consider a differential spherical triangle having the sides λ, ds, and $\lambda + d\lambda$, in which

$$\operatorname{Cos} (\lambda + d\lambda) = \operatorname{Cos} \lambda \operatorname{Cos} ds + \operatorname{Sin} \lambda \operatorname{Sin} ds \operatorname{Cos} \xi$$

and by the known processes of the differential calculus, we find

$$\frac{d\lambda}{ds} = -\operatorname{Cos} \xi \quad \frac{d^2\lambda}{ds^2} = \operatorname{Sin}^2 \xi \operatorname{Cot} \lambda \quad \frac{d^3\lambda}{ds^3} = \operatorname{Sin}^2 \xi \operatorname{Cos} \xi (1 + 3 \operatorname{Cot}^2 \lambda)$$

Introducing these values in (a), we obtain

$$\lambda' - \lambda = -s \operatorname{Cos} \xi + \tfrac{1}{2} s^2 \operatorname{Sin}^2 \xi \operatorname{Cot} \lambda + \tfrac{1}{6} s^3 \operatorname{Sin}^2 \xi \operatorname{Cos} \xi (1 + 3 \operatorname{Cot}^2 \lambda) + \text{------}$$

and substituting L, L', and Z into this expression, we have, for the difference of latitude

$$L - L' = s \operatorname{Cos} Z + \tfrac{1}{2} s^2 \operatorname{Sin}^2 Z \tan L - \tfrac{1}{6} s^3 \operatorname{Sin}^2 Z \operatorname{Cos} Z (1 + 3 \tan^2 L) + \text{----} (b)$$

It will be readily seen that the first term expresses the distance on the meridian PB from B to p, the foot of the perpendicular from A ; the second term, the distance very nearly from p to the parallel passing through A ; while the third term is a further approximation, and so on.

Referring now our case to an imaginary sphere, having the radius equal to N, or its centre at the point where the normal An intersects the polar diameter of the spheroid, we have

$$s = \frac{K}{N}$$

Substituting which we have

$$L-L'=\frac{K\,Cos\,Z}{N}+\tfrac{1}{2}\frac{K^2Sin^2Z\,tan\,L}{N^2}-\tfrac{1}{6}\frac{K^3Sin^2Z\,Cos\,Z}{N^3}(1+3\,tan^2L)+\cdots\quad(c)$$

This difference of latitude is, however, referred to a sphere whose radius is N, and requires still to be transformed by referring it to one whose radius is the radius of curvature in the meridian for the middle latitude, R_m. Since we do not at first know the middle latitude, it is more convenient to refer to the radius of curvature R of the starting-point, the latitude of which is known, and then seek the small correction due to the ratio of R to R_m.

Multiplying, then, equation (c) by $\frac{N}{R}$, and dividing, moreover by arc 1″, in order to express dL in seconds of arc we get,—

$$-dL=\frac{K}{R\,arc\,1''}Cos\,Z+\tfrac{1}{2}\frac{K^2}{R\,N\,arc\,1''}Sin^2\,Z\,tan\,L-\tfrac{1}{6}\frac{K^3}{R\,N^2\,arc\,1''}Sin^2Z\,CosZ$$

$$(1+tan^2\,L)+\cdots\quad(d)$$

The computation of this series is facilitated by tables giving the logarithms of the following factors to the argument of L, viz :

$$B=\frac{1}{R\,arc\,1''}\qquad\qquad C=\frac{tan\,L}{2\,NR\,arc\,1''}$$

moreover, substituting in the third term the value of the first term, designated by h, we can write it

$$\tfrac{1}{6}\,h\frac{K^2\,Sin^2\,Z}{N^2}(1+3\,tan^2\,L)$$

and tabulate another factor

$$E=\frac{1+3\,tan^2\,L}{6\,N^2}$$

when our formula for computation becomes

$$-\delta L=K\,Cos\,Z.B+K^2\,Sin^2\,Z.C-h\,K^2\,Sin^2\,Z.E+\cdots\qquad(e)$$

In order, finally, to obtain the true dL referred to R_m, we must increase δL by $\frac{R-R_m}{R_m}\,\delta L$

Now

$$R - R_m = a(1 - e^2)\left\{\frac{1}{(1 - e^2 \, Sin^2 \, L)^{\frac{3}{2}}} - \frac{1}{(1 - e^2 \, Sin^2 \, L_m)^{\frac{3}{2}}}\right\}$$

$$= a(1 - e^2)\frac{\frac{3}{2} e^2 (Sin^2 \, L - Sin^2 \, L_m)}{(1 - e^2 \, Sin^2 \, L)^{\frac{3}{2}}(1 - e^2 \, Sin^2 \, L_m)^{\frac{3}{2}}}$$

by developing and neglecting terms involving higher powers of e^2; but $Sin^2 \, L - Sin^2 \, L_m = Sin \, (L - L_m) \, Sin \, (L + L_m) = \delta \, L \, Sin \, L \, Cos \, L$ very nearly, because $\frac{1}{2} \, Sin \, 2 \, L = Sin \, L \, Cos \, L$
hence we write

$$\frac{R - R_m}{R_m} = \frac{a(1 - e^2)\frac{3}{2} e^2 \, \delta \, L \, Sin \, L \, Cos \, L}{(1 - e^2 \, Sin^2 \, L)^{\frac{3}{2}}(1 - e^2 \, Sin^2 \, L_m)^{\frac{3}{2}}} \times \frac{(1 - e^2 \, Sin^2 \, L_m)^{\frac{3}{2}}}{a(1 - e^2)}$$

$$= \frac{\frac{3}{2} e^2 \, \delta \, L \, Sin \, L \, Cos \, L}{(1 - e^2 \, Sin^2 \, L)^{\frac{3}{2}}}$$

making

$$D = \frac{\frac{3}{2} e^2 \, Sin \, L \, Cos \, L}{(1 - e^2 \, Sin^2 \, L)^{\frac{3}{2}}} Sin \, 1''$$

we get for the desired corrective term,

$$\frac{R - R_m}{R_m} \delta L = (\delta L)^2 D$$

and we finally have for the true difference of latitude

$$-dL = K \, Cos \, Z.B + K^2 \, Sin^2 \, Z \, C + \delta \, L^2 D - h \, K^2 \, Sin^2 \, Z.E \quad (1)$$

which formula, although of a somewhat complicated derivation, is very simple and convenient in practical computation, with the aid of the tabulated factors B, C, D, E. The term $(\delta \, L)^2 D$ is here interposed between the second and third terms of the series proper, because the latter is frequently not required, being insensible when the distance K is less than about 10 miles, or log K in metres less than 4.23. The term $(\delta \, L)^2$D should be used whenever log h exceeds 2.31, and h^2 may be used for $(d \, L)^2$ in all cases where log K does not exceed 4.93.

The term depending on the fourth differential co-efficient, neglected in equation (a), never exceeds 0″.001 for $s = 1°$, or $K = 100{,}000$ metres, and may therefore be safely neglected in practice

For secondary triangulation, and when the sides do not exceed about 12 miles, or 20,000 metres, the formula (1) may be advantageously reduced to the following :

$$-dL = K\ Cos\ Z.B + K^2\ Sin^2\ Z.C + h^2 D \qquad (2)$$

In order next to deduce the angle APB between the meridional planes passing through A and B and intersecting in the polar axis, or the difference dM of the longitudes M and M' of the points A and B, counted from east to west, we avail ourselves of the latitude L' of B, which has become known by the previous calculation, and have simply, using the same notation as before

$$Sin\ \lambda : Sin\ \xi = Sin\ s : Sin\ dM$$

Referring s to a sphere the radius of which is the normal $Bn' = N'$, we have $s = \frac{K}{N'}$ and assuming for the present the small arcs s and dM proportional to their sines, we obtain

$$dM = \frac{K\ Sin\ Z}{N'\ Cos\ L'\ arc\ 1''} \qquad (3)$$

dividing by arc 1″ in order to obtain dM, expressed in seconds of arc. The table gives the logarithm of the factor

$$A = \frac{1}{N\ arc\ 1''}$$

which must be taken out for L'.

In order to correct for the assumption that the small arcs s and dM are proportional to their sines, we use a table giving the differences of the logarithms of the arcs and sines. ----------

We obtain, finally, the reverse azimuth Z' by considering that in the spherical triangle APB (fig. 2) we have the following relation :

$$Cot\ \tfrac{1}{2}\,(\xi + \xi') = tan\ \tfrac{1}{2}\ dM\ \frac{Cos\ \frac{1}{2}\,(\lambda + \lambda')}{Cos\ \frac{1}{2}\,(\lambda' - \lambda)} = tan\ \tfrac{1}{2}\ dM\ \frac{Sin\ \frac{1}{2}\,(L + L')}{Cos\ \frac{1}{2}\,(L' - L)}$$

but $$\xi = 180^\circ - Z$$

therefore $$Cot\ \tfrac{1}{2}\,(180^\circ - Z + \xi') = -tan\ \tfrac{1}{2}\,(\xi' - Z)$$

or $$-tan\ \tfrac{1}{2}\,(dZ) = tan\ \tfrac{1}{2}\,(dM)\ \frac{Sin\ \frac{1}{2}\,(L + L')}{Cos\ \frac{1}{2}\,(L' + L)}$$

Assuming the tangents of $\frac{1}{2}\ dZ$ and $\frac{1}{2}\ dM$ proportional to their arcs, and writing λ for the middle latitude, we have

$$-dZ = dM\frac{Sin\ \lambda}{Cos\ \frac{1}{2}\ dL}$$

and $$Z' = Z + 180^\circ + dZ$$

When the difference of longitude is very large, it may be necessary to correct for the error in the assumption that

$$tan\ \tfrac{1}{2}\ dZ : tan\ \tfrac{1}{2}\ dM = dZ : dM.$$

By an obvious transformation, we find the correction to be

$$+\tfrac{1}{12}\ dM^3\ Sin\ \lambda\ Cos^2\ \lambda\ Sin^2\ 1'',$$

for which we write $+dM^3F$, where F is to be taken from a special table, - - - -. This term is only 0″.01 when log $dM = 3.36$ and need never be used for secondary triangulation."

By this means we obtain the differences in latitude and longitude between consecutive points in a series, and hence the difference between the initial and terminal points.

This latter difference we may obtain by two other methods. Firstly, by means of polar triangles, assuming as pole a conveniently situate station of one of the triangles. In the first polar triangle will be known from the triangulation the two sides and the included angle, and as radii vectores are drawn to the other stations of the triangulation net, their position becomes known.

The computation continues until the initial and terminal points are included within one triangle, whence the differences of latitude and longitude can be obtained by the formula already given.

Secondly, by projecting the lines connecting the stations upon a meridian by parallels of latitude, and determining the lengths of the projections.

For difference of longitude the side of each triangle can be projected onto the mean parallel of the extremities of the side, and then the projections of the sides forming a continuous broken line between the initial and terminal points projected onto a common parallel, the one about symmetrically situate with regard to the series of triangles. The projections of the two remaining sides of an individual triangle serve as a check upon the projection of the other side.

From Professional Papers No. 24 U.S.A. we find: "Helmert gives the following formula for the difference of longitude in seconds of arc, of the ends of a geodetic line on a spheroid, the length of the line being s, the latitude of its ends B_1, B_2, and the azimuths at its ends $a_{1.2}$ and $a_{2.1}$.

The equatorial radius and the eccentricity of the spheroid are $a_\circ$ and e. The formula is

$$(1)\quad L_{1.2} = \rho'' \frac{s}{a_\circ} W \sec B \, Sin\, a \left\{ 1 - \frac{1}{24} \cdot \frac{s^2}{a_\circ^2} \left(W^2 \left[1 - Sec^2 B \, Sin^2 a \right] - e^2 \left[10 \, Sin^2 B - 1 \right] Cos^2 a \right) + \frac{1}{1920} \cdot \frac{s^4}{a_\circ^4} \left(1 - Sec^2 B \, Sin^2 a \right) \left(1 - 9 \, Sec^2 B \, Sin^2 a \right) + G l_6 \right\}$$

In this equation $W^2 = 1 - e^2 \, Sin^2 B$; $B = \dfrac{B_1 + B_2}{2}$; $a = \dfrac{a_{1.2} + a_{2.1} - 180^\circ}{2}$

ρ'' is the number of seconds in radius ; and Gl_6 represents terms of the 6th order, $\dfrac{s}{a_\circ}$ being of the first.

Representing the arc of the parallel of B included between two meridians by $P_{1.2}$ its value will be

$$P_{1.2} = a_\circ . \frac{L_{1.2}}{\rho''} . \frac{Cos\, B}{W}$$

and (1) may be written

$$(2)\quad P_{1.2} = s \, Sin\, a \left\{ 1 - \frac{1}{24} \cdot \frac{s^2}{a_\circ^2} \left(W^2 \left[1 - Sec^2 B \, Sin^2 a \right] - e^2 \left[10 \, Sin^2 B - 1 \right] Cos^2 a \right) + \frac{1}{1920} \cdot \frac{s^4}{a_\circ^4} \left(1 - Sec^2 B \, Sin^2 a \right) \left(1 - 9 \, Sec^2 B \, Sin^2 a \right) + Gl_6 \right\}$$

AZIMUTH BY MEANS OF TWO STARS.

The Executive Committee has requested the Committee on Geodetic Surveying to report on the paper "Azimuth by means of two stars," which appeared in last year's proceedings.

It is not very clear what practical purpose this method serves, when we have the superior and simpler method, given in the Manual of Dominion Land Surveys.

It appears somewhat antiquated for a surveyor in this progressive age to observe time and azimuth by standing behind a plumb line and noting the time of simultaneous occultation of two stars behind the string.

Thereafter pursuing a mathematical calculation from which evolve seconds of arc and seconds of time for azimuth and time respectively, quantities carried to a minuteness which does not appear warranted by the method of observation.

It is not explained how the computed azimuth can be utilized on the ground ; whether a picket is lined in with the plumb line and stars; nor even for what purpose the surveyor wants to know his watch correction to seconds.

Seconds of time become a desirable quantity when observing Polaris for azimuth, when not at elongation and especially when near culmination.

In that case the surveyor will determine time with his instrument and not by watching behind a plumb line, and if he is going to determine time by means of Polaris and another star in the same vertical he would undoubtedly choose the method of the Manual instead of that of the plumb line quoted. The former method is preferable too from the fact that it is not dependent upon the simultaneous occurrence of two events—Polaris and another star in the same vertical at the same moment. In the method of the Manual, Polaris is observed at any time, the instrument clamped in azimuth and any other star near culmination observed in that vertical.

The surveyor that does any kind of work must have an instrument commensurate with the accuracy of the work aimed at ; there must be harmony in methods, instrument, observation and work.

" Figures don't lie" is very true, but from them very wrong inferences can be drawn. From the most indifferent observations we can, by the inexorable formulæ of trigonometry deduce values expressed to fractions of a second ; but are such values an index of the merits of the work ? Certainly not. No chain is stronger than its weakest link.

To return to the method and formulæ of Mr. Brabazon. His formulæ are interesting from a mathematical point of view to show how the azimuth and hour angle may be computed, and as such merit the perusal of surveyors, but for application in the field the method of the Manual, as stated, is preferable.

OTTO J. KLOTZ,
Chairman of Committee on Geodetic Surveying

REPORT OF STANDING COMMITTEE ON PUBLICATION.

To the President and Members of the Association of Dominion Land Surveyors.

Gentlemen,—

The Standing Committee on Publication beg to submit the following Report of the printing and publishing performed since our last annual meeting:

As will be seen, the printing of the last report of the proceedings of this Association was again awarded to J. Lovell & Son, of Montreal, and we hope that you will all agree with us in saying that the style of the above report is very creditable and that it is now in such a form as may be continued from year to year.

The total amount of printing and publishing is, as follows:

1000	Copies of the Sixth Annual Report of the proceedings of this Association.
1000	Book wrappers with name of the Association and the Sec.-Treasurer's address.
1000	Sheets of letter paper with engraved headings.
400	Folder programmes of this meeting.
250	Circulars containing a synopsis of the Sixth Annual Report.
250	Receipt forms and book.
125	Circulars of notification of this meeting requesting presence and a contribution to the same.
125	Circulars of enquiry regarding assistance towards inaugurating an annual dinner.
100	Nomination papers.
125	Ballot papers with voting instructions.
100	Ballot papers or slips containing name of one candidate for the Executive Committee.
125	Ballot envelopes.

Owing to the increased demand for the Annual Reports, it was deemed necessary to have one thousand copies printed, an increase of three hundred over the previous year. This committee congratulates the Association on the success it has attained, as is exhibited by the increase in volume, substance, demand, and therefore numbers of the last report; and in order to reduce the expence of publishing, we beg to suggest that it would be advisable to omit the constitution and by-laws as well as other matter that may not be considered absolutely necessary.

The outlay for the last report has been very heavy, but it was felt that an extra effort had to be made to place the Association among those of first-class standing, and we feel satisfied that the object desired has been accomplished and that it will produce a beneficial result to this Association.

We are pleased to note that seven members of the Association have taken advantage of the splendid opportunity afforded them of adopting the Annual Reports as an advertising medium by inserting their professional cards at $1.00 for one-third of a page, and we would urge every member interested in this Association to take this means of assisting it, feeling assured that mutual benefit will be the result.

We congratulate the Secretary-Treasurer on the creditable and handsome design he has adopted for the heading of our letter paper as we believe that it tends to advertise the good standing of this Association.

In conclusion, we beg to remind you of the many interesting features and profitable results that must be attained by keeping a "Member's Record," and hope that you will favorably consider the suggestion of the same as published in the last Annual Report.

Signed on behalf of the Committee,

T. D. GREEN,
Chairman.

DISCUSSION.

O. J. KLOTZ.—"I think that the Constitution and By-Laws should not be omitted. They are very often handy for reference purposes."

SEC.-TREASURER.—"I beg to draw attention to the fact that our best exchanges do not print them every year."

On motion it was resolved that the report of the Committee be received and adopted, and that the matter of printing the Constitution and By-Laws be left in the hands of the Publication Committee for 1890.

REPORT OF STANDING COMMITTEE ON TOPOGRAPHICAL SURVEYING.

To the President and Members of the Association of Dominion Land Surveyors.

Gentlemen, –

As Chairman of your Committee on Topographical Surveying it becomes my duty to report to you on that subject.

Topographical refers to topography, the latter word having been taken almost bodily from the Greek language in which it is *τοπογράφια*, this word is in turn derived from the two Greek words *τόπαο* a place, and *γράφειν* to write or describe.

You will observe that topographical is used in distinction from geographical, the former meaning the description of a particular place and the latter referring broadly to the whole earth.

Webster's unabridged dictionary defines the English word topography as meaning: "The description of a particular place, city, town, "manor, parish, or tract of land; especially, the exact and scientific "delineation and description in minute detail of any place or region; "the science or art of exact delineation or description."

Worcester's dictionary defines the word as meaning: "A description "of the form of the surface of a limited portion of the earth's "surface, whether made verbally or by a graphic delineation, or a "description of the natural objects found upon it, such as rocks, trees, "streams, etc., together with all constructions, as roads, bridges, towns, "etc."

The prime object of a topographical survey is to permit the construction of a map shewing the topography of the tract of country surveyed.

From the definitions of the word given above and the works of the highest authorities, we arrive at the conclusion that a topographical map shows not only the natural or physical features of the country, but also all structures such as bridges, roads, buildings, etc.

Maps are sometimes incorrectly spoken of as topographical, as for example, the map of Manitoba and the North-West Territories. This map, although showing some topographical features, may be properly denominated geographical, since the scale is too small to shew other than very prominent topographical features. A map to be correctly denominated topographic must be on a sufficient scale and show accurately *all* topographical features.

In short, a milkman may put a little milk into water but that does not entitle him to call the whole mixture milk.

As before stated the base of a topographical map is a topograhical survey.

Prof. Johnson's definition as set forth in his "Theory and Practice of Surveying" is as follows: "A topogragical survey is such a one as "gives not only the geographical positions of points and objects on the "surface of the ground, but also furnishes data from which the character "of the surface may be delineated with respect to the relative elevations "or depressions."

When such a work is extended over any considerable area, it is based on a trigonometrical survey of a high order of precision and the geographical position of at least one of the initial points must be accurately determined by astronomical observation. Otherwise the geographical position is not known. To illustrate this we may say that Toronto is in Canada, but this does not define its geographical position: that can only be done by stating its latitude and longitude, or its exact position in reference to some point whose latitude and longitude are known.

The only topographical surveying, of which we have knowledge, carried on in Canada, is the photo-topographical survey of the Rocky Mountains, now in progress. Its initial point is the astronomical station at Calgary, whose latitude and longitude have been ascertained by Messrs. King and Klotz of this Association. The trigonometrical survey on which the detailed topographic work is based has been carried on by the writer and is precise, although not of the highest order of precision. For the purposes now aimed at, it is not necessary at present to make this work in the Rocky Mountains of the highest order as the extra cost might not be compensated by the immediate increased economic value.

When speaking of the highest order of precision it is meant that a base line is measured with a probable error of not more than 1 in 1,000,000, the angles measured with an instrument reading to single seconds or less, all possible precautions taken and all known refinements used in the reduction.

In our trigonometrical work the length of base adopted was the mean of two measurements, each of which differed from the mean .018 of a foot. Taking the mean of the two measurements as the correct length, the precision of either one will be measured by the ratio of .018 to 8118 or 1 to 451000, and the probable error of the mean will be 1 in 676500.

Owing to inability to obtain an instrument such as was desired in time for the work, part of the triangulation has been executed with a three vernier six inch alt-azimuth reading to .004 of a degree but which could be readily estimated to half that amount.

The instrument which it is proposed to use has a six-inch limb and reads to 2 seconds by means of filar micrometers. There will be quite sufficient difficulty in carrying an instrument of even this size to the tops of mountains from ten to eleven thousand feet high.

The subsidiary or secondary triangulation has been made with a 3½ inch prismatic transit reading to single minutes. The photographs, from which the topography is laid down on the plan, are taken from the various triangulation stations and auxiliary points called camera stations. The position of the latter is fixed by setting up the transit at the point and reading on three or more triangulation stations: it is advisable to also read on the camera station from one or more triangulation stations if possible. Azimuths and zenith distances are taken to two or more peaks appearing in each view.

In my report of last year will be found a description of some of the methods used in applying the photographs to plan making.

Mr. McArthur who has been carrying on the secondary triangulation and photographic work during the past year, is a member of this Committee and has been repeatedly asked to write something on the subject of this report, but has steadily refused to do so. You will therefore understand the want of matter on this subject.

The work now being carried on in the mountains has for its object not only the construction of a map, but is also intended to furnish points of departure for the survey of mining claims, timber limits and lands.

In the mountains, it is impossible to run a system of base and meridian line as on the prairie, and a triangulation probably affords the most accurate and economical base from which to operate.

A cairn is built at each triangulation station and it will be no excessive amount of work to determine and tabulate the position of each cairn with reference to the nearest theoretical section corner.

This being done a simple triangulation and an azimuth observation will serve to fix the position of the instrument ; or, as will often be the case, three or more cairns will be visible and by reading the angles and using the problem of the three points, the position can be found.

For rough work, compass bearings would probably serve.

In the portion of British Columbia where the lands are not laid out in regular townships and sections, I believe the system of triangulation above mentioned would offer special advantages. But a few weeks ago it was noticed in the newspapers that our citizens on the Pacific slope were agitating the making of extensive surveys. Now, if we can show that the carrying out of the system mentioned above would result in a complete map of the country and an accurate basis for future surveys at a less cost than any other method, it should be to our advantage.

From the experience we have had in the mountains, we believe that a sufficiently exact triangulation can be carried over the greater part of that Province and a topographical map made by photo-topography at a cost of from two and one-half to four cents per acre.

The men undertaking that work would require a slight knowledge of photography and the methods used in making a map from photographs The latter knowledge can be had from a book written by our Honorary President, E. Deville, Surveyor-General of Dominion Lands. In addition to the involved problems in descriptive geometry, the book deals with perpective and its application to the making of plans from photographs, also the instruments used in the work and the method of carrying on the subsidiary triangulation necessary for the determination of the geographical position and elevation of the points from which the photographs are taken. It may be said that it would be a great benefit to the members of this Association and to surveyors generally if the Surveyor-General could be persuaded to publish his book so that it would be available to every one.

Trusting that all herein contained may meet with your approval, and that next year's chairman will be able to report a large increase in topographical surveying, this report must be drawn to a close.

W. S. DREWRY, *Chairman.*

DISCUSSION.

A. O. WHEELER: "I think that Mr. Drewry's suggestion 'that it would be a great benefit to members of this Association and to surveyors generally if the Surveyor-General could be persuaded to publish his book so that it would be available to everyone,' should be put in the shape of a resolution and be transmitted to Mr. Deville."

W. S. DREWEY: "I may explain that Mr. Deville's work on this subject is the only complete work in existence suitable to the application of Photo-topography in Canada."

A resolution for transmission to Mr. Deville was then passed, expressing the hope that he would see his way to carry out the publication referred to.

On motion the report of the Committee was received and adopted.

REPORT OF STANDING COMMITTEE ON PERMANENT MARKING OF SURVEYS.

[This Report, although published in the Sixth Annual Report of the Association, was not presented at the Sixth Annual Meeting, owing to the unavoidable absence of the Secretary-Treasurer, in whose hands the same had been placed. It was laid before the general meeting in February last, and is now reproduced together with the discussion thereon.—*Sec-Treas.*]

> Man's life is but a surveying bout,
> And he's best engineer
> Whose perfect transit ne'er is out,
> Whose plan and lines are clear.
> OLD POEM.

With regard to carrying out the suggestions in the paper "on the permanent marking of public Surveys in the field," published in the Report of the D. L. S. Association, in March of the year 1888, the undersigned would observe:

That there are two points which seem to demand special consideration: 1st. By what means can Surveys be marked in the field, so as to perpetuate them; 2nd. How can the results of those Surveys be published in a concise and convenient form, so as easily to give whatever information can be derived from them.

The plough in the field, fire in the bush, are powerful agents for the destruction of timber posts. Trees are becoming too scarce to be spared for landmarks, and but for hard fighting with the fire every season, they would be even scarcer. Maps, to give accurate information, must be on a scale so large as to forbid their being published. Field notes are also difficult and expensive to publish, and occupy a good deal of space. If then Surveys are to be made permanent, and the information they furnish is to be given in such shape as to be easily packed away for future use, and yet to be always at hand, available for whoever wants it, there will have to be a departure from the wooden post and inscribed tree, and there must be some additional record of the work besides the usual plan and the report accompanying it. What then is to be substituted for the discarded landmarks, and what better method of recording shall we adopt?

It is hoped the accompanying table of co-ordinates, illustrated by a diagram of an imaginary Survey, will afford a satisfactory answer. Such a table is easily published, one page of a "blue book" would give enough for an extent of many miles. The diagram is nicely illustrative. A township plan showing the transit line of a Railway Survey being at hand, was taken advantage of, and a few hypothetical notes were added. A writer in one of the "exchanges" says: "if you leave plenty of marks, you have the Contractor (or whoever comes to disturb the survey lines) by the throat, the lines can be restored if necessary." It is presumed the *modus operandi* is obvious. Lot corners, creeks, houses, intersections of roads, serve for points of reference, and though some may be lost, enough will remain to make the survey permanent.

In an extensive exploratory Survey like that of the Ottawa Ship Canal, it would be difficult to give precise rules—the Surveyor would have to do the best he could. Rocks in remarkable places, as for instance at the head of an island, might be marked. Iron posts such as are used in the North-West would serve well for mile posts. They are light, imperishable, and useless for any other purpose, "Lo, the poor Indian" lets them alone, so the chances in favor of their permanency are good.

It is unfortunate that the services of Messrs. Webb and Dumais, who were appointed with the undersigned to act as a Committee, could not be obtained. This unaided effort to meet the wishes of the Association necessarily falls very far short of what might be expected from the better judgment and experience of those gentlemen; but it must be either this or nothing, and it is hoped its defects will be viewed with leniency. The endeavor is to show that Surveys may be made permanent at a trifling additional expense, and that the information forthcoming from them can be conveniently and concisely given, in a great measure if not entirely, independent of a map.

Submitted with deference by

S. L. BRABAZON,
Chairman.

PORTAGE DU FORT, 1st Dec., 1888.

P. S.—Since the above was written, the courses and distances of the transit line and the co-ordinates of the initial point of each course have been added to the table before mentioned. It is scarcely necessary to say that as long as one recorded mark can be found, any other can be established by means of it. Corners of lots, in a settled country, may be regarded as permanent marks, conflicting interests tending to preserve them. The data are more than sufficient for the utilization and permanency of the Survey, but the work would be more complete and valuable if permanent bench marks had been made and were recorded.

TABLE of co-ordinates of certain points in the Township of Eardley, County of Ottawa, Que., determined by the survey of the Montreal Northern Colonization Railway, the axis of X being the meridian, and that of Y a line perpendicular thereto.

		Co-ordinates.	
		X.	Y.
	Origin of co-ordinates on E outline of Eardley 19.5 chs. from S. E. boundary of Township on the bank of the River Ottawa	0.00	0.00
	S. Boundary post between Eardley and Hull	—19.50	+ 2.00
1	S. W. corner of Lot 2, R. II	55.00	—58.50
2	S. W. corner of 3, R. III, 9 chs. W. of Aylmer Road	131.50	94.50
3	S. E. corner of 5, IV, 4 chs W. of Aylmer Road	208.50	128.40
4	S. W. corner of stone foundation of M. X's dwelling house on Aylmer Road	243.75	150.00
6	S. W. corner of 8, VI	283.00	191.00
7	S. E. corner of 13, VII	427.00	361.00
8	S. E. corner of 17, VIII	484.00	474.00
9	S. E. corner of 20, IX	553.00	564.50
10	S. W. corner of 23, X	613.50	676.50
11	Intersection of transit line with E. fence of road 33·50 chs southerly from Aylmer Road	650.00	723.50
12	Rock marked with a cross thus +	670.00	755.50
13	Intersection of transit line with W. outline, 62 chs. from S. W. corner	654.60	873.30
14	S. W. corner of Eardley, Latitude 45° 31′, 36″.6 as determined by Deville	593.50	806.35

No. of Line	Transit Line.		Initial Point.	
	Course.	Distance chains.	X.	Y.
1	315° 00′	115 75	0.00	0.00
2	336 30	54 50	81.50	83.00
3	359 00	41 00	130.00	105.60
4	329 00	85 50	171.00	107.50
5	300 30	37 95	243.50	155.50
6	328 00	26 00	261.50	187.50
7	340 00	61 50	283.00	202.00
8	305 30	623 50	340.00	226.00
9	258 30	60 00	670.00	755.00

Convergence of Meridians say 1′ 4″ p. 100 chains.

(NOTE.—The diagram referred to in the above Report may be found in the 6th Annual Report of the Association.—*Sec.-Treas.*)

DISCUSSION.

THE PRESIDENT: "Sufficient prominence is not given to the marking of surveys. One of our members—Mr. McLatchie—during the past season, has made a suggestion in this connection. He proposes that iron posts and mounds shall be placed at all section corners in timbered country, instead of marking the corner with post and bearing tree as is now the custom. I am in favor of his suggestion and have done what I can to forward it.

Mr. Brabazon's report refers to settled country and is more appropriate to Railway Surveys than to those made by Dominion Land Surveyors."

WM. CRAWFORD: "During the last six years I have spent a great part of the time tracing old lines. This year I have had more experience than in any previous one. I consider that the ploughing up of mounds is an act of vandalism. I have come across an instance of one man who had ploughed up seven mounds, and in my report I referred to that man as perpetrating an act of vandalism."

THE PRESIDENT: "That was an act of carelessness, and the matter at present under consideration is the perpetuating of marks."

WM. CRAWFORD: "I think such men ought to be prosecuted."

THE PRESIDENT: "During the last year, one man was arrested for moving survey marks. He was tried, convicted of felony and sentence now hangs over him."

WM. CRAWFORD : "I just mentioned this to show the inconvenience surveyors were at."

A. O. WHEELER : "Were a triangulation survey of the country once instituted, the usefulness of Mr. Brabazon's suggestions would in a very large measure be done away with."

J. F. SNOW : "The boundaries of lots are established by law, and therefore Mr. Brabazon's methods could not be adopted."

On motion the report was received and adopted with the understandstanding that the matter should be left in the hands of the Committee on Permanent Marking of Surveys for the ensuing year.

REPORT OF STANDING COMMITTEE ON NATURAL HISTORY AND GEOLOGY.

February 18th, 1890.

TO THE PRESIDENT AND MEMBERS OF THE ASSOCIATION OF DOMINION LAND SURVEYORS.

GENTLEMEN,—

After carefully reading and re-reading Mr. Drummond's "Suggestions for Surveyors Repots" I am more than confirmed in the opinion that his suggestions are of the utmost value, not only to Surveyors, but to all explorers who describe a tract of country which may be practically unknown to others than themselves. It *is* necessary for a surveyor to give all the topographical features of the country traversed, but is it not as necessary that he should indicate the timber with which it is covered, if a forest district, and if on the prairie the leading grasses? How much more valuable is such a report than one giving only the surface features?

It is not merely the vegetation but the birds, mammals and even insects that should be noticed, and if you choose, above all, the rocks, because these indicate the soil and the soil the productions ; for we all know quite well that a region of sand is quite distinct in all its features from one where limestone predominates.

Although not asked to suggest a means by which Mr. Drummond's suggestions can be easily carried out I would say, nevertheless, that my Catologue of Canadian Plants indicates the range of all our trees, gives the common and scientific names, and a very slight acquaintance with it would enable any one to tell what trees he saw in the district where his work might lie. Regarding the general geology, I may say, a few sentences descriptive of the work, written on the scene, and a few specimens brought away would enable any practical geologist to tell the horizon of the district in question.

A still more important matter is one that I have long felt should be adopted by our Department.

In no case should a topograpical survey party of any magnitude be sent out without a geologist and a naturalist being of the party. By not doing this many opportunities of acquiring very valuable information at a nominal cost have been lost and many years may elapse before another chance may occur.

When the Americans were surveying their interior they always did this and to-day their Survey Reports of nearly 40 years ago are models of thoroughnesss and have never been set aside. Were I in a position to make my voice heard I would have the complete survey of a district done at one and the same time so that a complete synopsis of the topography, natural history and geology of a district could be published simultaneously and in such a form as to be useful for all time. I know I am talking to men who have different views from myself in many matters, but we all know there is a right way and a wrong one, and dispassionate examination will show that to make a valuable and exhaustive report on any district the three branches spoken of above must be combined in either a greater or lesser degree. It follows then that Mr. Drummond's "suggestions" are timely and well worthy of more than a passing thought.

JOHN MACOUN,
Chairman.

DISCUSSION.

PROF. MACOUN—"If any gentleman will ask me a question I will show him the usefulness of my Botanical Catalogues."

J. J. MCARTHUR—"Professor, you have been in the neighborhood of Lake Winnipeg. What would you call the jack pine in that district ?"

PROF. MACOUN—"*Pinus Banksiana*, or northern scrub pine, so called after Sir Joseph Banks, the discoverer."

WM. OGILVIE—" I have heard it called pitch pine in the neighborhood of Edmonton."

PROF. MACOUN—" This is the same species if found east of the Rocky Mountains."

J. J. MCARTHUR—" Some of the trees I refer to were eighteen inches in diameter."

WM. OGILVIE—" The ones I have seen were only small."

PROF. MACOUN to Mr. Ogilvie—" Were you ever on the Clearwater River? There you will see the same kind of large size. There are three species of pine closely related. East of the Rocky Mountains, *Pinus Banksiana* ; in the Rocky Mountains and westward, *Pinus Murrayana* ; and on the Pacific Coast, *Pinus contorta.* To a casual observer these are all the same, but the locality where found would show the species on referring to my catalogue."

WM. OGILVIE—" What is the difference between black spruce and white spruce ? "

PROF. MACOUN—"The chief distinctions to a common observer are the cones and the trunks. The cones of the white spruce are long and finger shaped and the trunk is light coloured. In the black spruce the cones are quite short and dark brown or purplish, while the bark is black. There is still another species, viz: the Rocky Mountain spruce, which is distinguished from the white spruce by its cones being much thicker and the scales being undulated, not smooth."

JOHN VICARS—" What are the big pine trees you see in British Columbia ? "

PROF. MACOUN—" The Rocky Mountain pine is a white pine like our eastern pine but named *Pinus monticola* (Douglas or western white pine). Another pine is found in the dry parts of British Columbia which is a fine stately tree and named *Pinus ponderosa*, on account of the height of the wood."

J. J. MCARTHUR—" Is there not a close affinity between hemlock and Douglas fir."

PROF. MACOUN—"In general appearance they look much alike, but the cones of the Douglas fir are quite large and with spinose scales, while the cones of the hemlock are very small and without spines."

JOHN VICARS—" We found a tree looking like cypress last year, near Coquitlam Lake. What was that ? "

PROF. MACOUN—" That is yellow cedar and extends all the way to

Alaska, and from it the Coast Indians build their large canoes. Where you saw it, it would be at least 1000 feet above the sea as it does not come to the sea level in that latitude."

JOHN VICARS—"We found it about two miles from the sea coast, high up. We got another tree up there called a larch. It looked like a balsam."

PROF. MACOUN—"The larch is the ordinary tamarack, and no larch grows in that region."

JOHN VICARS—" It looked much like balsam."

PROF. MACOUN—"In that case it was what is called *Abies grandis* or giant balsam. It is a fine, tall, large growing tree with white bark and may be seen rising from the woods like stately columns."

WM. OGILVIE—"Is not the common tamarack the larch."

PROF. MACOUN—"Certainly it is."

JOHN VICARS—"Some years ago in Algoma we came across a little ern that had a sweet scent like a geranium."

PROF. MACOUN—"That was the *Aspedium fragrens* or sweet-scented fern and is the only fern with a perfume. It is quite common around Lake Superior."

THE PRESIDENT—"Gentlemen I consider that this is one more kindness on the part of Prof. Macoun, and I think that the members should try and carry out Mr. Drummond's suggestions in accordance with the Professor's ideas."

PROF. MACOUN—"When Dr. Dawson goes out into any part of the country, he brings in botanical specimens and states where he found them; then I name them, and thus he gets the correct name in his reports."

THE PRESIDENT, to Prof. Macoun—"What steps would we have to take to obtain your Botanical Catalogues?"

PROF. MACOUN—"I should think that an application should be made direct to the Minister of the Interior."

WM. OGILVIE—"I shall always be pleased to do anything I can to forward the Professor's views. Anything I have already done in that direction is due to the Professor. The suggestions made are very valuable and we should go to work to carry them out. Too much, however, must not be expected of surveyors. I have often seen specimens I would like to have carried away but my duties as a surveyor absorbed all my attention, and it was only occasionally I could get the opportunity to do as I would wish in this direction."

PROF. MACOUN—"Mr. Ogilvie is correct. The Surveyor has not the time to attend to other than his own business. Topography, natural history and geology should be worked together. A naturalist and a geologist should be sent in connection with the topographical survey. If you want natural history, send a naturalist. If you want geology, send a geologist. The naturalist learns from the surveyor and the surveyor gets the practical knowledge of the naturalist."

On motion the Report of the Committee was received and adopted.

THE PRESIDENT—"I have much pleasure in conveying the thanks of the meeting to Prof. Macoun and I heartily concur in his remarks and suggestions."

PROF. MACOUN—"I will write to the Minister of the Interior and urge upon him the benefits of Members of the Association being in possession of my Botanical Catalogues."

WM. OGILVIE—"Professor, have you seen Mrs. C. P. Traill's 'Plant Life of Canada'?"

PROF. MACOUN—"Yes, I consider it an excellent work."

REPORT OF STANDING COMMITTEE ON LAND SURVEYING.

TO THE PRESIDENT AND MEMBERS OF THE ASSOCIATION OF DOMINION LAND SURVEYORS.

GENTLEMEN,—

The solution of the "Subdivision of a Quadrilateral Figure," which was submitted at the last Annual Meeting of the Association, by Mr. H. Irwin, D.L.S., of Montreal, and a paper entitled "A Standard of Precision," which was submitted at the same time by Mr. J. A. Kirk, D.L.S., of Stratford, having been referred to the Committee on Land Surveying, they beg to report thereon as follows:

1st. The "Subdivision of a Quadrilateral Figure."

The Committee have examined the solution of this problem. It is a very valuable addition to problems in surveying, but as a practical question will seldom come into requisition.

2nd. "A Standard of Precision."

Attention has been directed, by the writer of this paper, to the results which have been obtained from using a check chain on a survey. We will therefore introduce our remarks on it, by referring to the differences occuring in chaining with and without a check chain.

To make any experiments in chaining, it is necessary to have good, careful chainers. Experience with very careful chaining shows that chaining on level prairie is about two links to a mile longer than over hilly and broken prairie, or over windfall and brush in the woods.

To remedy this defect, it is easy to add to the chaining over rough country the amount of error determined from experimenting. On all measurements made, even by experts in chaining, the distance has been found short wherever there was much plumbing to do. When a check chain of one hundred feet in length was used on surveys of standard meridians and parallels, the difference in measurement was very slight on prairie. When chaining over uneven and broken country, the long chain gave the most accurate measurement ; the reason of this being that it was often necessary to break the short chain in crossing a deep ravine, while the long chain passed over it without necessitating a break. When the surface was uneven and broken, the difference was usually from one to two links to a mile, the average being about one and a half links to a mile. On level ground the chain, one hundred feet in length, gave shorter, and over uneven and broken country, longer measurement than the one sixty-six feet in length.

The conclusion arrived at, would therefore be, that with ordinary care in chaining the limit of error would not be more than one and a half links to a mile. This might be called the standard of lineal precision. But it must be remembered that in those measurements the chains were compared with the same standard, and the same allowance was made for temperature. Different chainers were employed, but they had equal experience in chaining and had received the same instructions and training.

If all chains could be compared with the same standard, or were of equal length ; if the temperature remained always the same, or the correction to apply was constant ; if there was always true alignments in chaining ; the same pull on the chain and correct plumbing ; if all the chainers employed on surveys were equally experienced and careful ; if all surveys required the same degree of accuracy and precision, then there would be no difficulty in formulating a standard of lineal precision.

In making a traverse survey of a lake, when eight or ten courses are run, the closing angle should be found not to exceed one minute in error. In making a traverse survey of a river, which runs across a township, the angle at the intersection of each section line should not exceed one minute in error. The above remarks refer entirely to an ordinary traverse of a lake or river, where the object in view is merely to locate the lake or river, for the purpose of obtaining the area of the broken sections in which they are situated. In such a traverse survey of a lake or river, where the angles are only noted to minutes, if the angle measured to the forward picket does not give an exact minute, note the nearest one, making an allowance by offsetting at the forward picket for the difference between the reading and the angle noted. The distance to offset is easily deduced from the length of the course. In a hurried lake or river traverse, should this be attended to, there will oftener be no closing error, than one of one minute.

In making a traverse survey, such as that of the Canadian Pacific Railway, which was to be used as a base line, and where angles were required to be measured as exact and precise as possible, no such errors as given in this lake or river traverse would be admissable.

Many instances could be given on the survey of Standard Meridians and Parallels, which when checked by other surveyors, were found not to differ over ten seconds in bearing. On block suveys, lines run by different surveyors on opposite sides of the correction line road allowance, one chain and fifty links apart, and which were started from independent astronomical observations, have been found at the width of a township not to vary more than ten seconds in bearing. When the work was at all carefully done, the errors hardly ever reached thirty seconds in bearing, and this was owing to error in the production of the lines caused by high wind, refraction, or a smoky atmosphere. Under ordinary circumstances, a line started from an observation should not be found over thirty seconds in error in bearing when run the depth of a township. This might be called the standard of angular precision.

If all surveyors were alike careful in their operations ; if all instruments were of equal stability and as perfect in construction ; if good light was always available ; if pickets could always be set at equal distances ; if there were no high winds, refraction or smoky atmosphere, there would then be no difficulty in formulating a standard of angular precision.

A low standard of precision would only produce careless work. An example of which is found in the limit of error given for closings in sub-division surveys. A high standard of precision should have an opposite tendency, so long as it is not unattainable.

A difficulty which presents itself is this, that a number of standards would be necessary, according to the degree of accuracy and precision required for different surveys.

With or without a standard of precision, it is the duty of each surveyor to take advantage of every opportunity to check his surveys so as to locate and correct an error, if any, before leaving the ground. Besides this each surveyor should have a standard of precision of his own. If he makes it high, more care will have to be exercised on his part to attain it.

In the event of a survey being disputed, the party disputing its correctness, would in all likelihood employ another surveyor to check it, and thereby entirely ignore any standard of precision adopted by the Association.

In attempting to make a survey even approximately correct, the surveyor is beset on all sides with many difficulties.

It would therefore appear from the difficulties which present themselves, that the Association is not warranted in formulating or adopting any standard of precision.

JOHN McLATCHIE,
Chairman.

On motion the Report of the Committee was received and adopted.

REPORT OF SCRUTINEERS OF BALLOTS.

FEB. 19th, 1890.

TO THE PRESIDENT AND MEMBERS OF THE ASSOCIAOTIN OF DOMINION LAND SURVEYORS.

GENTLEMEN,—

We the undersigned scrutineers appointed to examine and count the ballots sent in for the election of officers for this Association for the current year, beg to report that we have performed that duty, and find the following gentlemen to have received the highest number of votes.

For PRESIDENT - - - - - -	Wm. Ogilvie.
〃 VICE-PRESIDENT - - - - -	Samuel Bray.
〃 SECRETARY-TREASURER - -	A. O. Wheeler.
〃 EXECUTIVE COMMITTEE - - -	O. J. Klotz. J. S. Dennis. John McLatchie.
〃 AUDITORS - - - - - - -	J. F. Snow. F. Driscoll.

JOHN McLATCHIE,
J. E. SIROIS,
J. J. McARTHUR.

On motion the Report was received and adopted.

Notices.

EIGHTH ANNUAL MEETING.

The Eighth Annual General Meeting of the Association will be held at Ottawa, commencing on the Third Tuesday in February, 1891.

All members who read these pages, will clearly see that the principal aim of the late Executive Committee has been to make the Association of some practical use to the Profession. If not successful it cannot be said that the effort has not been made, and I think that a glance at the President's Address will show that some results have been attained.

The object of this notice is to call upon all members to lend their assistance toward the success of the coming Eighth Annual Meeting. In order to make this meeting a success, there *must* be a good programme. You are therefore requested to furnish a paper suitable to this occasion.

If you cannot furnish a professional paper, prevail upon some one who can to do so. Surely in the course of your professional career you have met with some matter that has raised a question or is of special interest from a professional point of view and which, it would benefit you to have discussed by the General Meeting. Then why not put it in shape and submit it to the said meeting?

Later in the year, you will be specially invited to interest yourself in this direction and lend your assistance to the Executive Committee on behalf of the programme for the Eighth Annual Meeting; *then*, bear this notice in mind and although it may cause you a little personal inconvenience, you will feel the better for having contributed your quota to the general good.

Secretary-Treasurer.

ANNUAL DINNER.

The first Annual Dinner of the Association was an unqualified success. Thirty-six tickets were sold and eight invited guests were present. The dinner was served in the dinning-room of the House of Commons, special permission having been obtained from the Speaker. Among the guests present were the Deputy Minister of the Interior, Dr. Selwyn, Dr. Dawson, Prof. Macoun, the Surveyor-General, Dr. Bell, Mr. A. T. Drummond and Mr. W. F. King. The dinner was followed by an adjournment to a smoking room, supplied with a good piano, and the balance of the evening was spent most enjoyably, excellent entertainment being kindly furnished by Messrs. O. J. Klotz in English and German songs; Wm. Ogilvie, recitations; D. C. Morency French songs; P. D. C. Dumais, Italian song; D. W. Davis, M. P., Indian dance; J. C. Nelson, song, and J. F. Snow, first-class music. The gathering broke up during the small hours next morning, all vowing that a more enjoyable evening had never been spent.

Members are strongly advised to spare no effort to be present at the Dinner to be held at the close of the Eighth Annual Meeting in February next.

Secretary-Treasurer.

Obituary.

Since our Annual Meeting we have to record the death of one of our members in the person of Mr. John Frederick Snow, D.L.S., who died very suddenly of heart disease, in the City of Ottawa, on the morning of April the 11th, 1890.

Mr. Snow was born in the Township of Hull, in 1852, and after completing his early studies he, in 1868, went to Victoria College, where he remained for a year, and then accompanied the Hon. Wm. McDougall, in 1869, to Red River. Returning home after a few months absence he began his service in the Profession under articles to his father, also serving some time with Bolton Magrath, Esq., and Robert Sparks, Esq.

In 1874 he became a P. L. S., for Ontario, and during the same year was admitted to practice in Quebec. In both of these Provinces he had a wide experience in surveys, both in conjunction with his father and by himself.

He received his commission as a D. L. S. in 1880, and during the seasons of 1883 and 1884, he worked for the Government on subdivision surveys in the North West Territories.

He was among those who were present at our first Association Dinner, and being an excellent musician, he contributed largely to the success on that occasion.

Mr. Snow was widely known among the Profession and was universally liked.

OTTAWA, May 7th., 1890.

Questions Submitted.

"MORE OR LESS."

FEBRUARY 1st, 1890.

TO THE PRESIDENT AND MEMBERS OF THE ASSOCIATION OF DOMINION LAND SURVEYORS.

GENTLEMEN,—

I beg, to lay the following question before you for consideration :

Should a surveyor, when preparing, for insertion in a deed or patent, the description of a block, lot or parcel of land surveyed by him, apply the words " more or less," either actually or in effect to the length of any course or every course, the terminal points of which have been located by any of the following methods :—

1. By a wooden, iron or stone post, perpetuated by a bearing tree, witness mound or other mark.
2. By a wooden, iron or stone post in a stone or earthen mound.
3. By a wooden, iron or stone post only.

My reason for bringing this matter before you, is that during the past two years in my official work, the above question has frequently been raised, and contentions have been advanced both for and against the use of the words " more or less " as applied to any but the closing course of the block, lot or parcel of land which has been encompassed.

Let me state the following case as an example, and ask for your ruling in the instance cited.

The surveyor has been employed to lay out a certain parcel of land as a mining location, and with his returns of survey he sends the following description for insertion in patent.

" All and singular, etc., ...commencing where a post has been planted on the water's edge of Lake Superior to mark the N. W. corner of said mining location, said post being distant one hundred and sixty-four $\frac{41}{100}$ (164.41) chains east ast. and eight (8) chains north ast. from the N. E. corner of the N. E. quarter, Sec. 12.

20.15 W. of the 91st meridian, thence east ast. twenty (20) chains, thence south ast. twenty (20) chains, thence west ast. twenty (20) chains to the water's edge of Lake Superior, thence northerly along the said water's edge twenty (20) chains more or less to the place of beginning."

On referring to the field-notes of survey it is found that at the south west corner of the location has been planted an " oak post in stone mound," at the south-east corner has been planted a " poplar post with bearing tree," at the north-east corner a " poplar post with bearing tree " and at the north-west corner, an " oak post in stone mound."

On the above grounds the surveyor's description is challenged and it is required that the distance to posts should be given as " more or less."

In his defence the surveyor claims that were his description so amended it would be erroneous and entirely at variance with his own custom or the custom of any surveyor whose practice he is acquainted with. He states that the closing distance is given as " more or less," but that if the others were so given, how would it be possible to retrace the lines were some of the posts missing.

In conclusion I beg to state that it is my intention that the question submitted should apply only to original surveys and not to subdivision of an original survey. In the first case the description is dependent upon the survey, in the second the survey upon the description.

Trusting that I shall receive a definite answer to my question and a distinct ruling in the case cited.

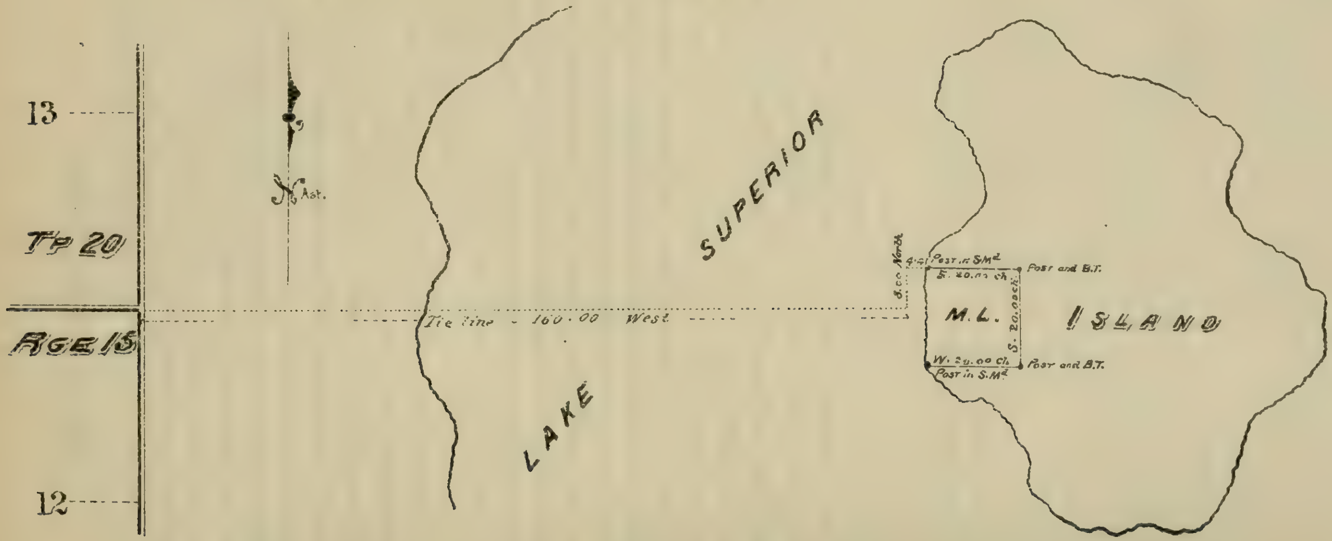
I have the honor to be,
Gentlemen,
Your obedient servant,
ARTHUR O. WHEELER.

REPORT OF COMMITTEE ON LAND SURVEYING ON THE ABOVE QUESTION.

To the President and Members of the Association of Dominion Land Surveyors.

Gentlemen,—

In reply to the subjoined questions, submitted at the present meeting of the Association, by Mr. A. O. Wheeler, D.L.S., and referred to


13
Tp 20
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12
N. Ast.
LAKE
SUPERIOR
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W. 20.00 Ch
Post in S.Md
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Post and B.T.
M.L.
ISLAND

the Committee on Land Surveying to report thereon at this meeting, the Committee beg to report as follows :

Question :—"Should a surveyor when preparing, for insertion in a deed or patent, the description of a block, lot or parcel of land surveyed by him, apply the words "more or less," either actually or in effect to the length of any course or every course, the terminal points of which have been located by any one of the following methods:

1. "By a wooden, iron or stone post, perpetuated by a bearing tree, witness mound or other mark."

2. "By a wooden, iron or stone post in a stone or earthen mound."

3. "By a wooden, iron or stone post only."

Before entering into a direct reply it is desired to draw attention to the following clauses of the Dominion Lands Act, and also to the Regulations for the disposal of Dominion Lands containing minerals.

Clause 129 of the Dominion Lands Act establishes mounds, posts or monuments, in any original survey, under authority of the Dominion Lands Act, as true and unalterable ones. By clause 130 the measurements given in the patent do not govern, but the mounds, posts or monuments of such original survey do.

By clause 47 of the Dominion Lands Act, the Orders-in-Council regarding mineral lands, and the surveys thereof, are brought within the operations of the Dominion Lands Act, and hence any mounds, posts or monuments planted in the survey of such mineral lands for patent, become the original, true and unalterable ones.

Clauses 7 and 8 of the above Regulations provide that the survey of all mining locations must be performed by a surveyor duly commissioned to survey Dominion Lands, and acting under instructions from the Surveyor General. These latter clauses came under the heading of Quartz Mining, and it is inferred that for any other mining location, the survey should be made under instructions of the Surveyor General.

Clause 13 of the Regulations provides for the dimensions of locations for iron or petroleum, but does not specify especially how, and under what authority the survey for the location is to be made, but as before stated, one would infer that it must be made under instructions of the Surveyor General.

As to question 1, we are of opinion that if a description by metes and bounds is given of any mining location, the distances between any mounds, posts or monuments which have been planted, in the original survey, must be qualified by the words "more or less" as such mounds, posts or monuments are, as we have seen by clause 129 of the Dominion Lands Act, the true and unalterable ones.

A Bearing Tree only becomes a factor when it is necessary to re-establish a lost corner ; a Witness Mound for determining the corner to which it refers ; neither a Bearing Tree nor a Witness Mound having anything to do with the description for a patent.

Question 2. In case the post (of whatever material) has been planted in a mound (of whatever material) and so designated in the original plan, then in the description the post should be referred to as being in a mound, stating the material. The distance to such post being as above "more or less."

Question 3. The answer is the same as for No. 1, being so many chains "more or less" to the post.

In short, the distance between any two mounds, posts or monuments in an original survey, must always be given as "more or less" for a patent.

Discussion of the description submitted in the example cited by Mr. Wheeler.

"Commencing where a post has been planted at the water's edge of Lake Superior, to mark the north-west corner of said mining location, said post being distant 164.41 chains, east astronomically, and 8 chains north astronomically, from the north-east corner of the north-east quarter of Section 12, Township 20, Range 15 west of the 91st Meridian." Now this point of commencement is relegated to two points and one line ; the two points not only, do not necessarily coincide, but very probably do not do so. nor do either of them necessarily fall or come for all time in the water's edge. In short, highly improbable, if not impossible, conditions are placed upon the point of commencement. The question arises, what should govern the post planted on the original survey : the water's edge or the distance from some peviously established point ? As we have seen that the post in an original survey is the true and unalterable one, therefore it must govern, and the point of commencement must be at the post (in mound in this case).

Hence the following is suggested : "Commencing where a post in stone mound has been planted adjoining the water's edge of Lake Superior, and distant, according to the measurement of John Smith, D. L. S., 164.41 chains east astronomically, and 8 chains north astronomically from the north-east corner of the north-east quarter of Section 12, Township 20, Range 15 west of the 91st Meridian."

Then, continuing, the description should read: "thence east astronomically, twenty chains, more or less, to a post; thence south astronomically, twenty chains, more or less, to a post; thence west astronomically, twenty chains, more or less, to a post in a stone mound; thence north astronomically, twenty chains, more or less, to the place of beginning."

According to clause 13 of the Regulations quoted, the location "shall be bounded by due north and south, and east and west lines, and its breath and length shall be equal." It therefore follows, that in a description for a patent, the irregular line of the water's edge cannot be made a boundary line, although practically, it may become so by making the north and south, and east and west lines project into the lake.

In reply to the assertion, "that the closing distance is given as 'more or less,' but that if the others were so given, how could it be possible to retrace the lines were some of the posts missing?"

From the tenor of the latter part of the above, one would infer that "more or less" is of such broad meaning as to include any measurement whatever; far from such is its meaning. When we say "twenty chains more or less to a post," it means that the line is to terminate at the post, not at twenty chains, and the fact that a measurement has been given shows that there is some authority for giving such measurement; but as no measurement is absolute, it follows that the distance to a fixed point must be "more or less," which words "more or less" are equivalent to saying "that the distance to the post is, according to the measurement of John Smith, D.L.S., twenty chains (no more or less)."

In retracing any line, where some of the original posts have been lost, evidence precedes measurement, and where evidence is wanting the measurements govern as provided by statute.

John McLatchie,
Chairman.

DISCUSSION.

John Vicars—"Why use 'more or less' when you have a fixed point, as no distance is absolute?"

J. J. McArthur—" I do not see why."

Prof. Macoun—" I think the use of the words ' more or less ' is scarcely wise. John Smith's survey is disputed and is rechained on each side. The lawyer now comes in with absolute distance."

John McLatchie—" All original survey posts are fixed points, and the distance to same must be more or less."

D. C. Morency—" Theoretically no block of land, of which the limits are north and south and east and west lines can be laid out in a square. It would be better to insert the words ' more or less' when applied to a fixed point."

Wm. Ogilvie—" Taking the view that no measurement is absolute the words ' more or less ' should apply. No limit of absolute measurement has yet been laid down."

J. J. McArthur—"In other countries a limit has been laid down."

Wm. Ogilvie—" Well, none in Canada. Too much importance is attached to the words ' more or less.' "

D. C. Morency—" The question should be settled. There should be a way of adding something to these words that would make them apply more definitely and therefore cover the question from a lawyer's point of view.

On motion the Report of the Committee was received and adopted.

Lectures.

SYNOPSIS

OF A LECTURE ON ASTRONOMY, BY W. F. KING, CHIEF ASTRONOMER TO THE DEPARTMENT OF THE INTERIOR OF CANADA.

The lecturer began by saying that having had the good fortune to happen upon a number of views illustrating astronomical facts and theories, and Mr. Topley having kindly consented to exhibit them with the sciopticon, he would confine himself this evening to saying a few words in explanation of each view as it appeared on the screen.

The first four views showed the solar system, illustrating different theories which had been proposed to explain the apparent motions of the sun and planets.

The first view exhibited the earliest motion of the solar system. The Earth is fixed in the centre, about it circle the Moon, Venus, Mercury, the Sun, Mars, Jupiter and Saturn, in the order named. Beyond all these planets revolves the celestial sphere carrying with it the fixed stars. The earth is the centre of the universe. This theory not being sufficient to account for the observed movements of the planets, a later theory makes the Earth the centre as before, with the Moon revolving about it. Beyond the orbit of the Moon revolves the Sun, the Sun carrying with it, and revolving about it, Mercury and Venus. Beyond the Sun's orbit lie Mars, Jupiter and Saturn, revolving, not about the Sun, but about the Earth.

In the third theory the Earth is still in the centre with the Moon revolving about it. Beyond circles the Sun, about which all the planets, superior as well as inferior, revolve, and are carried with it around the Earth. The fixed stars also revolve about the Earth.

Finally the fourth view gives the correct theory of the solar system. Here the Earth loses its primacy; it is only one among the planets, controlling no other body than its own Moon. The Sun stands in the centre, and the planets revolve about it.

The next views showed the relative sizes and distances of the planets together with their astrological symbols, a reminder of the time when the planets were supposed to have an intimate connection with affairs on the earth. These symbols are still used in astronomical publications, for the sake of brevity, instead of the names of the planets.

Some forms of nebulous matter were shown, indicating the manner in which stars are formed, if the nebular hypothesis is true. A view was also shown of the milky way, as an elongated cluster of stars, of which our sun, with its attendant planets, is a rather insignificant member.

Several views were now shown of the planets as seen through a powerful telescope: the crescent Venus—the markings on Mars—Jupiter's belts—Saturn's rings.

Then came the Earth divided up by meridians and parallels, and showing the different zones. An explanation was given of the relation of the arctic and antarctic circles, and the tropics to the seasons.

Some views followed, illustrating the phases of the moon, and lunar and solar eclipses. The obliquity to the ecliptic of the moon's orbit was shown to result in the fact that an eclipse dose not take place at every new or full moon; the moon has to be within a certain distance of one of the "nodes" of its orbit for an eclipse to occur. The action of the moon in causing tides was also illustrated Also the illumination of different parts of the earth at the solstices and equinoxes, showing the variation in the length of day and night, and the seasons, as accounted for by the obliquity of the earth's equator to the plane of its orbit.

Another diagram showed the relative orbital motions of the earth and the inferior planets, Mercury and Venus, and an explanation was given of the "direct" and "retrograde" movements of these planets, the "stationary points," &c.

Next followed a diagram of the signs of the zodiac, showing the fanciful figures devised by the astrologers to represent these constellations, viz.:

> "The Ram, the Bull, the Heavenly Twins,
> And next the Crab, the Lion shines,
> The Virgin and the Scales,
> The Scorpion, Archer, and He-goat,
> The Man that holds the watering pot,
> The Fish with glittering tails."

The lecturer concluded by exhibiting (with the lantern) diagrams of several well known constellations, Taurus, Ursa Major, Orion, Cepheus, Cassiopeia, Sagittarius, Aquarius, Perseus, showing the stars in each as they appear in the heavens, together with the outlines of the objects they were supposed to represent. The fanciful and arbitrary nature of the constellations was apparent in these views, although this classification is commonly used advantageously in naming and identifying the brighter stars.

SYNOPSIS

OF A LECTURE GIVEN BY H. N. TOPLEY, ENTITLED "A PRACTICAL CHEMICAL DEMONSTRATION OF THE BROMIDE PROCESS."

The lecturer began by stating that he would give a simple but practical demonstration of the Bromide process without entering into the difficulties which arise from using impure chemicals. Placing before his audience a glass containing some gelatine, and after dissolving and cooling to the proper temperature, he added some bromide of potassium and dissolved it. The next important step was to add the nitrate of silver, which was done; these solutions being heated to about 150 degrees Far. the silver was then added to the bromide in a fine stream (in the darkroom). Three different ways of mixing were then explained. First, two funnels are joined at their outlets; then filtering cotton being placed in the funnels, the two solutions are poured and the fine streams uniting and falling into the beaker, produce an emulsion in a very fine state of division. The second mode is by inserting a funnel into the glass beaker, and filtering the nitrate of silver through absorbent cotton, drop by drop, until one-third of the solution is emulsified; then the liquid is allowed to run through in a fine stream, both solutions being heated to about 150 degrees Far. The third way is considered the most simple and best suited for amateurs. Mix gelatine and bromide of potassium with the proper amount of water and a few drops of nitric acid. Heat the solution to 120 degrees Far., just enough to dissolve the gelatine. Take the crystals of nitrate of silver and drop a few of the smaller pieces into the bromide solution; keep it well stirred with a glass rod until the last trace of silver is disolved. To test whether an emulsion has been properly mixed proceed in this manner: take a piece of plain glass, then with the stirring rod spread some of the emulsion on the surface of the glass and hold it toward the light, it will now appear a deep ruby color by transmitted light, and a straw yellow by reflected light. When satisfied that the emulsion has been carefully mixed, the glass containing the emulsion is now placed in a water bath and the water is brought to the boiling point as soon as possible and allowed to remain boiling for half an hour, the emulsion in the meantime being stirred every ten minutes during the time it has been cooking; now take a small portion of the cooked emulsion and proceed to test as before, this time you will notice that your emulsion is no longer a deep ruby, but a pale blue by transmitted light. The emulsion is now set aside to cool. The gelatine is weighed out and soaked in water for a few minutes and then added to your emulsion at about 150 degrees Far. until dissolved; it is then placed in a cool room to set. When cool it has the appearence of very stiff blanc mange.

The emulsion is now squeezed through coarse linen into a vessel covered over with cheese cloth, tied over in such manner as to sink down in the middle. The emulsion is washed until all the soluble bromides are eliminated. If this is not properly done the result will be that the finished plates will appear foggy, and develop very slowly. Next take the emulsion and put it into the melting pot; while this is being dissolved place the last of the gelatine (this should be Heinrich's Hard or Siemon's Hard Swiss gelatine) to soak. Then add it with the proper quantity of water to make up the amount. After dissolving the emulsion it is now ready for filtering, this is done in a warm room. If the emulsion does not measure 128 oz. add water; use filtering cotton; fill the cotton with hot water and put it into the neck of the funnel, not too tight. If the emulsion passes through too fast press down the cotton until it runs in a fine stream or very frequent drops. Before coating the plates it is as well to test the molecular deposits. Should the particles appear coarse and uneven through a magnifying glass the operation of mixing and cooking has been carelessly performed. It will be noticed that there is a large deposit of a coarse bromide of silver remaining in the filtering cotton, thus depriving the finished emulsion of its full amount of sensitive bromide of silver, making plates with less body, and without latitude both in exposure or development. The coating is done by pouring the emulsion into the coating pot. This is a small tea-pot with a spout from the bottom. The excess is poured back into the pot to be used over again. After the plates are coated they are placed on a marble slab to set. When enough have been coated to cover the slab the first ones are picked up and put in racks to dry, which generally takes about six hours.

Successful platemaking is due more to the practical details and chemical changes (photographically speaking) than anything else. The following is a formula for the emulsion :

No. 1.

Water distilled	36 oz.
Alcohol	4 oz.
Glacial Acetic Acid, enough to redden litmus paper.	
Bromide of potassium	3 oz, 6 drachms.
Iodide “	80 grains.
Gelatine (Henrich's soft)	480 grains.

Place all the above in a one gallon flask and put the vessel in water and raise to 160 degrees Fahr.

No. 2.

Water	36 oz.
Alcohol	4 oz.
Nitrate of silver	5 oz., 2400 grains.

Place all of No. 2 in another flask and heat to 160 deg. Far. No. 1 and No. 2 being now at 160 degrees, mix the solutions in a fine stream in the dark room. Everything prior to this can be done in daylight.

Mr. Topley next developed two negatives, one having received about the correct time, the other one double the exposure. The first proved fairly good, but over exposed. The second also a good negative. This was to demonstrate the restraining power or control one has in developing, when given the time of exposure and circumstances under which they were taken. Afterwards two dried negatives were exhibited to the audience made by the above process and developed with the following formula :

No. 1.

Pyrogallic acid	1 oz.
Sulphite of soda	1 oz.
Citric acid	30 grains.
Water	8 oz.

No. 2.

Water	7 oz.
Sulphite of soda	1 oz.
Bromide of potassium	300 grains.
Liquid ammonia	1 oz.

To use take one drachm of each to 3 oz. of water.

The gelatine bromide printing process was next explained. A large negative had been taken for this purpose, that all present might observe the gradual appearance of the image during the process of development. Next a piece of bromide paper having been adjusted on negative and placed in the printing frame, a small hand lamp lit to make the exposure. The frame containing bromide paper was turned face down on the table until all explanations were given, then placed at about three feet from the light and an exposure of 90 seconds given. It was developed with the following developers:

Saturated solution of neutral oxalate of potass. 6 dr.
Saturated solution of poto-sulphate of iron.... 1 dr.

Both solutions made acid with citric acid just enough to turn litmus paper red, and used in the above proportions, the picture came out slowly, clean and brilliant, and to the astonishment of all present it proved to be a portrait of a man with a large—yes, very large, open mouth, labeled with large letters "the Department of the Interior, Technical Branch." Some thought it was a portrait of McGinty. Afterwards the picture was fixed in a solution of

Hyposulpite of soda....	1 oz.
Water......................	4 oz.

REMARKS

ON NATURAL HISTORY, WITH SPECIAL REFERENCE TO CANADIAN FISH, BY PROF. JOHN MACOUN, BOTANIST AND NATURALIST TO THE DEPARTMENT OF THE INTERIOR OF CANADA.

Prof. Macoun said that he would give an account of the standing of Natural History in this country, in order to obtain the assistance of Dominion Land Surveyors.

The natural history of the country was not on the proper footing. It was not as well known in some respects as it should be. Little or nothing was known about the fish. No other country on God's earth to day has such valuable fisheries in the waters around its coasts; and neither did the people know it nor seem to care to know it. It was a pretty serious charge to make, but that was just how the matter stood at present. Preachers said that to spread the Gospel they must talk in season and out of season; he believed in spreading his own particular fad (natural history) in season and out of season. He hoped to get assistance from land surveyors. Everybody going out to explore should have some knowledge of natural history. Before 1872 he had studied botany for a number of years, and he would show conclusively that it was only by a knowledge of botany and natural history that he had been able to substantiate the statements he had made in connection with the North-West years ago. What had he seen? He had seen the same plants and grasses growing in the Peace River district as grew in Ontario. He had reasoned that if grasses and plants ripened in the two localities at the same time the climate must be similar. The statements had been founded upon fact and they remained good until to-day.

As far as the botany of Canada was concerned, all known plants were now classified and catalogued, and he had published four volumes of the same under the auspices of the Geological and Natural History Survey of Canada, and was now working at the fifth.

A complete catalogue of Canadian birds was ready for the printer. Over six hundred different kinds of birds had been catalogued; their ranges, breeding places and so forth.

Mammals also were pretty well catalogued.

Surveyors could not be of much assistance as far as birds were concerned. Birds fly and might be found in three or four different localities in the same year. What was wanted were small mammals.

Small mammals bred and died within a small area and might be considered as representatives of that locality. They required the skin and the skull. To skin the animal, just split down the centre of the stomach and pull the skin over the head. Each skin and skull should have a tag with a number to correspond upon it, and the tag should also show the date and place where killed. All kinds of mammals were necessary. Why? Because twenty, thirty, forty years might elapse before we would get the same opportunities of acquiring the knowledge. Last year he collected a large number.

Very little was known about reptiles and less about fish. No man to-day could give a complete list of the Canadian fish; so it might be seen how little was known.

It was true that very few fish were to be found in the Ottawa River owing to the sawdust infamy; but in the Rideau Canal how many knew what species were to be found? As far north as he knew, people lived on white fish. Who could say how many kinds there were? There are a dozen different kinds of suckers; twenty or thirty different kinds of trout; what do we know more than this? Sir John Richardson had studied our fish before most of us were born, and they have never been studied since.

The Senate Committee had asked him if he could put the matter straight and get up a full list of the fish, and when he told them that we knew as much sixty years ago as now, Senator Schultz was surprised. "What!" said he, "can this be so?" One man called it a trout—another a greyling—a third, a char. What did we know, who was right? They knew nothing, nor did we.

There are shoals of fish on the West Coast, cod and halibut, and their value is neither known nor cared for. He had seen shoals of them twelve to fourteen feet below the surface and a dogfish would dash in amongst them and scatter them right and left. Only Indians fished for them, and they caught all the big halibut. What are they?—only fish. The Minister of Marine had been in correspondence with Dr. Selwyn to see if something could not be done towards increasing our collection, and he was happy to say that he would be authorized to pay more attention to them during the coming season, and he desired to enlist the gentlemen of the Association in the same good work. We had a fine collection as far as it went; were all named, and what was wanted was to supplement this collection. We wanted in the same museum a complete series of food fishes and also the smaller fishes that were food for the larger ones, so that scientific visitors from either Europe or the United States could see at a glance what the waters of Canada produced. If we could show what fish there were and had them properly catalogued, visitors would say, "Why! these people are awake." Could it be said now? No, sir! Only that we had the grandest fisheries in the world. Where was the proof? Americans had men going into Hudson's Bay for fifty years and we did not know what they take out of it, and what is more, did not seem to care. Within the past week he had had some correspondence with Mr. Wilmot, who had charge of the fish propagating establishment of the Department of Marine and Fisheries, and he (Mr. Wilmot) had told him that the proper way to preserve fish skins was a very simple one. All that was necessary was to skin the fish, but not to be particular about taking all the flesh off the skin; then keep the skin in a strong brine for a few days, and after that it would be an improvement to throw that out and put on fresh brine. Leave it in it for a week or two. If you should catch any big fish this summer, let the cook take off the skin, no matter about flesh being on it, and treat it as he had already said, and then pack and address to Mr. Wilmot, Dept. of Marine and Fisheries, Ottawa, and you will have done something for your country. The place where caught and the length and weight of the fish should also be sent, as this information was necessary. It was every man's duty to obtain and spread knowledge of his country. He wanted to see Canada in her proper place. These were the co-efficients. What we wanted were the facts. Send the articles and they would soon be put in the proper shape. He would see that the natural history of the country was in as good shape as the botany. Americans said that for fifty years no botanical work as good as his had been published and they were now going to get something in the same style.

The Professor concluded by saying that the meeting must excuse his selfishness, for when a man talked of himself he was selfish.

DISCUSSION.

The President—Nothing is selfish that is for the public good. The Professor has time and again asked us to assist him. I would like to say to the members that they should try and do somewhat to meet the Professor's views. I have myself done nothing and have not made use of my opportunities, but will try and do so in the future. If all surveyors who go out would bear in mind and when possible would meet the Professor's views, it would only be paying him for his trouble in bringing the matter so ably before us. I agree with Prof. Macoun that we know almost nothing about fish. In the western part of the Territories you may catch half-a-dozen different kinds of fish with half-a-dozen different names; and which of these names are correct? I hope you will all try and carry out the wishes of Prof. Macoun."

W. S. Drewey—" Professor, did you ever, on the West Coast, catch a salmon with a fly?"

Prof. Macoun—" I never caught a fish with a fly in my life, and what is more, I think it is waste of time."

Papers.

WANT OF PRECISION IN SURVEYS.

The members of this Association are doubtless quite familiar, from their own experience, with the want of precision in surveys.

In the early surveys of the older provinces of the Dominion, the surveyor was obliged to use the magnetic compass. Subject as it is to so many variations and to local attraction, it is not to be wondered at, if the original surveys were not precise. Add to the use of the compass, the link chain, which was liable to *stretch*, and which was probably never checked on surveys of long duration, and you have a sufficient reason to account for the long measurements made.

The use of the compass is now almost abandoned, especially on surveys where precision is required. In Ontario and Quebec it is used for tracing out and determining the boundaries of timber berths, which are defined by lines run magnetically. The compass is also used to a certain extent, in defining such boundaries. The declination of the needle is determined from an astronomical observation, and the line is then run with the compass, allowance being made from the astronomical bearing of the line equal to the declination of the needle. This line is called an astronomical line, and is returned as such to the Crown Timber Office. The same method has been followed to some extent, in the survey of timber berths in Keewatin and the North-west Territories; and is also followed in the determination of astronomical lines in the public surveys of the Province of British Columbia. Lines run in this manner, with a compass in the hands of a careful operator, would not be very far wrong, still there is no certainty in the work. The compass has had its day; its usefulness is gone, and it must go. It is only to be regretted that it was used so long; still it was easily and conveniently carried in rough and mountainous country, although uncertain in use. It has been truly said that "although never precise, and seldom accurate, it was generally not very far wrong."

With instruments almost perfect in construction, and capable of being easily adjusted, and with the use of the steel band chain, which does not *stretch*, the surveyor is now placed in such a position, that his work should be practically correct. This is not the case, however, as in some instances improved instruments and chains have not produced correspondingly improved surveys. This can be easily verified by an examination of some of the surveys made with them. An error of a minute in bearing produces a deviation of only about two and one half links to a mile; errors in chaining should not exceed that amount. When errors in bearing exceed one minute, and in chaining two and a half links to the mile, the question naturally arises, what is the cause of this want of precision. In answer, I say the want of precision in surveys may be attributed principally to carelessness, on the part of the surveyor. Carelessness on his part in not being exact and precise in in his own work, such as taking astronomical observations, measuring angles, producing lines, making calculations and triangulations, and in giving proper instructions to the chainers, picket man and other employees. If the surveyor is careless in his own operations, the members of his party will be careless in theirs also. There is a great deal in example, more than is generally supposed, and I may say, as a rule, that the members of a survey party will be governed by the example set by the chief of the party. If he finds it too much trouble to go half a mile to offset a post at the commencement of the survey, they will find it too much trouble to do so, before the survey is completed. He must insist on accuracy and precision, and have it understood that nothing else is admissable.

I would gladly omit another cause of want of precision, but as all the trouble does not arise from carelessness, I will mention ignorance, and in some instances ignorance of the first principles of surveying. That such is the case, however, cannot be denied, and I don't mention it by chance, but because I know it to be a fact. I can point out several townships, amongst the early surveys in Manitoba, that have been surveyed by men who were totally incapable of doing the work they had undertaken. One, however, will suffice for the object I have in view. If you should stop at a particular section corner in this township, you will see three mounds, and although the posts have been moved from one mound to the other in turn until placed in the third mound erected, the rejected mounds have not been destroyed. If you can determine the third mound erected by finding a portion of the remains of the old post in it, you are then in a position to check the survey. Measure east, west, north and south from this mound and you will not find the quarter section posts placed on the lines connecting the section corners; some are one, some are two and some are five chains off line, while none of them are placed midway between the section corners. If you go all over the township, you will see two or three mounds at each section corner, while the quarter section posts are invariably out of position. The number of mounds erected at the section corners give evidence that the surveyor had made several attempts to correct the survey. That it was executed to the best of his ability, I have no doubt; at the same time it gives ample evidence of his incompetence and ignorance in conducting a survey. Happily not many surveyors were employed on subsequent surveys, who through incompetence and ignorance produced such blunders, as are to be found in this survey.

Again many surveyors undertake surveys, which from the scientific knowledge they possess, and from practical experience, they are not fitted to execute. In surveys where consummate skill is required in the manipulation of instruments and in making abstruse calculations, it is absurd to suppose that they would be undertaken by those who have no practical experience, or are not possessed of the necessary scientific knowledge. In the same manner, no surveyor should undertake to determine the azimuth of a line, even by the simplest methods, who has no practical experience with the use of the transit, or knowledge of the calculation required.

As coming under this class, I may mention those who are constantly giving an exhibition of their knowledge of surveying by talking about the adjustments and use of instruments, interspersed with astronomical problems, but who have never adjusted an instrument properly, or taken an astronomical observation correctly. In fact, who could not be relied on to measure a distance with any degree of accuracy with the chain, to make a calculation in plane trigonometry or determine a distance accurately by triangulation.

Another cause of want of precision is the desire to make money in a hurry, apparently forgetting that " he that maketh haste to be rich is not wise." Many surveyors on contract surveys, instead of trying to close the lines on the section corners, are quite satisfied if they come within the fifty link limit, allowed by the Manual of Surveys; and indeed it is not surprising, if some of the lines are found beyond that limit. A rigid inspection of contract surveys, with a reduced limit of error, necessitating the re-survey of lines in the woods, when they are beyond the limit allowed, would have a healthy effect in procuring a greater degree of precision.

The public demand for cheap surveys is put forward, in private practice, as an excuse for want of precision. The surveyor cannot afford to pay the expenses of an assistant, competent to superintend the chaining, and it is not always convenient for the surveyor to do so himself. The employer considers that the expenses of the surveyor are quite enough for him to pay, making no provision for correct measurements with the chain, on which the surveyor's work is based. In private practice, when I have suggested that it was necessary to take at least one experienced chainer with me, I have been told that competent men could be procured to carry the chain where I was going, and so save the expense of bringing one with me. On short surveys it is not possible for a surveyor, without great loss of time, to properly train the chainers. I have found it necessary in my private practice, to take one end of the chain myself, and even then the chaining has not always been as carefully done as it should have been. I always sympathize with a surveyor employed on private surveys, whose practice does not warrant him in securing (and at his own expense if necessary) a trained and reliable assistant who could look after the chaining. The want of such an assistant has often led to errors in measurement of considerable magnitude, and the surveyor employed is held responsible for the error, instead of his employer. It is not to be wondered at, if the surveyor who is employed on work of this kind, year after year, should become careless in the performance of his own duties.

I will just mention one instance that occurred in private practice, my informant being one of the chainers employed on a survey of a side line between two lots in a township in the Province of Quebec. When the line had been opened out in the woods, over a rocky and mountainous country, about half the depth of the concession, the surveyor chose two of the axemen, who never had had any experience in chaining, to go to the front of the concession, to chain the line. They were duly sworn, and without receiving any instructions were sent back to chain. They made ten wooden pins, and commenced chaining along the line without any regard to the uneven surface over which they were passing.

On reaching the working party, the surveyor wanted to know how many chains they had measured; neither of them knew, and in fact, were quite astonished at the question asked by the surveyor. If they had lost a pin on the way, they would likely have replaced the lost pin with another, and still would have been chaining to the best of their knowledge. This may be an extreme case, but the same thing is going on from day to day, in a greater or less degree. In defence of the surveyor employed, I may state, that the line, being a trial line, was not chained for the purpose of dividing the distance between the concession lines, but merely for offsetting, so as to give the position of the true line, between the posts at the front and rear of the concession, so that for the purpose intended the chaining might have been a little carelessly done withou affecting the survey to any great extent.

I have been asked the question, "Why do not surveyors furnish their own chainers on private surveys?" I have answered, "Simply because the employer will not pay the additional expense incurred in taking chainers, as he wants a cheap survey; and the surveyor goes without them, because he cannot afford to remain idle on account of an empty purse."

The chainers being an important element, on all surveys, whether public or private, as regards precision, none should be chosen to chain excepting those who are careful and conscientious. Careful and conscientious because they have to be sworn, and if they are not both careful and conscientious, the fact of their being sworn does not make the chaining correct. The chainers being sworn, complies with the law, and legalises the survey, which is as much as can be said in its favor. I would prefer to judge of the accuracy of the chaining, from the closings, rather than to depend upon correctness, based on the fact that they were sworn.

The surveyor cannot be too careful in his choice of chainers (if he is allowed the choice). Even then he will find some men, otherwise intelligent, who will never become experts in chaining. The fault, however, often lies with the surveyor himself in not training the chainers to do their work properly. No matter how accurately the surveyor may perform his share of the work, either in the measurement of angles, or the production of lines, the closings will never be satisfactory if he has to depend on careless chaining.

He ought therefore to keep a constant watch over the chainers so as to prevent them from adopting and practising careless methods. This is especially desirable at the commencement of the season's work and until they have been taught to chain correctly. If a pin is lost, don't admit of any guess work, but have them chain again from the last tally. If an error has occurred in the measurement of a line, or if there is a difference in measurement of two lines, that should be of even length, have them chained over again to ascertain where the error has been made. If the second chaining of the lines is not satisfactory, have them repeat the operation until they chain correctly ; and it will do no harm for the surveyor to take a hand at the chaining himself, as it will show them the importance he attaches to their part of the work. There is nothing, that I am aware of, has a more salutary effect, or is more conducive in producing good chaining, than to give the chainers extra work to do in correcting their own errors. Have it distinctly understood that at every closing that is in error, the same course will be pursued, and I venture to say that it will not occur very often.

There is another difficulty in connection with chaining, which may be worth mentioning, that is, carelessness produced by over confidence. When the chainers have learned to chain correctly and have been doing good, careful work for a time, they become over confident and consequently careless, because they imagine they cannot chain wrong. Being unexpected, errors in chaining, occuring in this way, are very annoying to the surveyor. On this account, I have usually found it necessary to waken up the chainers, once or twice during the season.

The surveyor should be careful with his own work, so as to be in a position to check the chaining ; as he should be able to tell from it what the closing ought to be, or within what limit it ought to be. If his own work has been carefully done, he is in a position to attribute the closing error, if any, to the chaining. If he cannot depend on his own work, because it has been carelessly done, it would be unwise to attribute the error to the chaining. My experience warrants me in saying, that there must be carelessness on the part of the surveyor himself, if his work produces a greater error in closing than a link or two to the mile.

When rapidity of work, as well as precision is desired, much depends on the picketman. The surveyor should, therefore, select the most active and intelligent man of his party as picketman. He should be a man of good judgment, and should be able, with a little practice, to choose the best points for the production of the line. In crossing valleys in the woods, he should keep the line clear overhead, and direct the axemen so as to avoid unnecessary chopping; and should be able to select the best base line obtainable for the triangulation of a stream or lake. In a wooded country, where it is necessary to make pickets for producing the line, he should be competent to make them straight and of uniform size and length. In fact he should be ready and willing to do anything and everything necessary to further the work, and thereby save the surveyor much trouble and annoyance. Those who have had experience with a slow, stupid picketman, can readily appreciate one who is active and intelligent.

The choice of an instrument is of considerable importance, and depends upon the degree of precision required on the survey. If the surveyor is going to run Standard Meridians and Parallels, he ought to have a six inch transit, of good workmanship, reading to ten seconds. On township lines a five inch transit reading to twenty or thirty seconds; while on subdivision surveys a four or five inch transit reading to one minute will do. It would be just as unwise to undertake a survey of Standard Meridians and Parallels with a four inch transit reading to one minute, as it would be to undertake the same work without the necessary qualifications to perform it. I am not in accord with the surveyor who made a hobby of buying old instruments that had been thrown aside as worn out and useless by other surveyors; just because he wanted to show how accurately he could perform a survey with them. It would be well enough to experiment with them at home; they are not desirable, however, as a part of a surveyor's outfit for prosecuting surveys. The cost of instruments, of good make, is now so moderate, and they are so easily procured, that the use of anything but a good one should not be entertained. I believe that a surveyor commencing practice should have the best instrument, of the kind he wants, that can be procured, one perfect in construction and that can be readily adjusted. I do not believe in using an instrument that requires to be adjusted every day. It ought to be so well made that, with careful handling, it would not require to be adjusted during a whole season's work. The surveyor, having supplied himself with a good instrument, and having placed it in proper adjustment, is supposed from practical experience to be competent to lay down a meridian line from an astronomical observation.

In running Standard Meridians and Parallels great care is required, because the work should be exact and precise, and there is no check until the block is closed. We will suppose that the surveyor has been careful in determining the azimuth, and producing the lines run; that the chainers have been careful in their measurements, and in making due allowance for temperature; that the picketman at each station chosen has been careful in plumbing the pickets, and in noting the points given for the production of the line; and that the closing of the block has been satisfactory and creditable to all concerned. There has, however, been something forgotten on this survey: the pickets set on the lines will not last forever, and there is nothing else to mark the lines run, as the posts have not been placed on them. The surveyor has evidently left this part of his duties for the chainers to do, but as the pickets have been set far apart, they have done the best they could, under the circumstances, by placing the posts on their chaining line. Sometimes, they are set in a curve to one side, and sometimes to the other, while in the valleys and ravines they are farther off line than on level land. It will be difficult to define those lines when the pickets are gone, while the surveyor could have placed the posts on the lines with the instrument, when producing them, and saved this evidence of want of precision through carelessness. I have attempted to determine the bearing of a line posted in a manner similar to this one, and before I could do so, I found it necessary to run a line the full depth of the township. Even then I was not certain that I had obtained the true bearing, because the township corners may not have been placed in their true position. How easily the posts could have been placed on the lines when the survey was in progress; and how much more conveniently could the lines have been retraced when necessary to do so! I have often been surprised to find the posts placed in all conceivable positions off the lines, when they were carefully and well run, and the closings good. Usually the posts do not stand more than two or three links from the lines, but in valleys and ravines they have been found over fifty links distant from them.

In the survey of township outlines, in many instances, there is ample evidence of carelessness. Why rapidity of work was preferred to extreme accuracy has always been a puzzle to me. Evidences of rapidity of work, which engendered carelessness, are found in variable chaining; errors in measurement; errors in calculations, and triangulations; crooked lines; posts not set on the lines run; posts set on the wrong side of the road allowance, while on some trial lines the posts are off-setted; and on others, some are off-setted and some are not.

In the subdivision of a township into sections, we have an example of a survey where extreme accuracy is not required, and where the standard of precision is low.

While it is not desirable to expend too much time and labor in the prosecution of a subdivision survey, still the surveyor should, without loss of time, be able to run a line within one minute of the bearing required and the chainers should be able to chain a mile within two or three links of the true distance.

The work done would be more precise, if the surveyor were to spend a little time in opening out and measuring the north or south boundary of the township to be subdivided. This boundary could be used as a base line to project the Meridians from, after the inner angles of the township, adjoining this boundary, have been determined. It would also be necessary to measure carefully part of the east and west outlines, so as to be able to compare your chaining with the chaining of the outlines, and to modify it so as to agree with the same. If there are no errors in the township outlines, you are now prepared to go on with the survey intelligently. Time spent in getting a good start, will be found to be time saved. If all your work has been carefully performed, there will be no lost time afterwards.

Great difficulty is experienced in producing lines on the prairie, during the months of July, August and September, on account of refraction and smoky and hazy atmosphere. Instead of using a cross stick on the back picket, which is difficult to see, under the above conditions of the atmosphere, a sod placed on it is a great advantage and is now generally used. During my first season's work in Manitoba, on open prairie, I had frequently to get the moundman to stand behind the back picket, so as to enable me to see it. The next season instead of getting the moundman to stand behind the picket, I had him place his hat on it. Being desirous of going early to camp one evening, the moundman placed a sod on top of the picket in place of his hat. The next day I placed sods on every picket set, making them of a size proportionate to the distance to the forward picket. I found them of so great advantage, that after a short time I used the sod to sight on, paying very little attention to the picket. In smoky or hazy atmosphere, I have been able to see sod distinctly, when only the dim outline of the picket was visible. Before using the sod I found that all east and west lines run curved slightly towards the north, because the point taken on the back picket was not its centre, the south side being bright and the north side shaded. In running westward this was easily verified by sighting on the back pickets four or five miles when the sun was shining directly on them. With the sod on the picket it is just the same whether you are running north and south or east and west. In taking a back sight it is not always necessary to sight on the sod, in fact, sometimes it is better not to do so, especially when there is much refraction. If you are using an instrument with two hairs crossing the horizontal one at a small angle, it is better to direct the telescope, so that the sod in its lateral motion will just touch the cross hairs above or below their intersection. If the sod in its lateral motion should overlap the cross hairs, move the telescope so that the sod will be farther from their intersection, and adjust the line of sight until it lies evenly between them. With the line of collimation almost true; I have found it a great advantage to place a sod on the forward picket also. I think it preferable to use a sod on the forward picket when there is much refraction, than to take the mean of two points when both are uncertain.

With a little care, in open, level and undulating country, there cannot be much error in the production of a line. This is also true, when long sights are taken in the woods, but this usually requires an enormus amount of time and labor to be expended in opening out the line, especially when pickets have been set from hill to hill. In crossing valleys, to avoid this loss of time and labor, the alternative is resorted to of setting pickets at short distances.

In producing lines in wooded country, where the surface is hilly and broken, I dispense with the use of a flag picket, having the picket man make the pickets as they are required. The method I have adopted for the production of a line where the pickets have to be set at short distances, and which I have found very convenient in British Columbia is as follows, viz:—

Adjust the line of collimation so that a sight taken direct and reversed will fall on the forward picket at a distance of ten chains. As soon as the first picket giving the direction of the line is carefully set, look for a reference object ahead on line, such as a dead tree, a white stone or anything that is definitely outlined. If nothing else is seen, the top of a tree on some distant hill or mountain will do. If there is nothing definite to note in sighting forward, then revolve the telescope and take a sight backwards and fix, if possible, a reference point in that direction, due allowance having been made for collimation. Then place the telescope in a vertical position, and set the back picket behind the instrument, with the eye, by placing it in line with the telescope and forward picket. If the picket can be set twenty or thirty feet back from the instrument, all the better. A picket of bright green wood, in fair light can easily be distinguished at a distance of fifteen chains, and in wooded country where it is hilly and broken, they are not often required to be set at a greater distance. The picketman is supposed to have left space enough in front of the forward picket to set the instrument, say from five to thirty feet, according to the nature of of the ground. Proceed now to the forward picket and pass to the front of it. A glance ahead is all that is required to decide if it is necessary to set a guide picket, to give the axemen the direction of the line, and save unnecessary chopping. If a guide picket is required, place the instrument so that the line of sight to the back picket will pass one side or the other of the front picket, you can then set the guide picket and if it is not exactly true, it is near enough for the purpose intended. Then proceed at your leisure to set the instrument in line by moving it to which ever side is required : level it, point the telescope towards the picket, and place it in a vertical position. If the telescope is not in line with the two pickets, repeat the operation until it is in line. Push the front picket to one side, set the telescope on the back picket, revolve, it and you are ready to set the forward picket. Practice makes this the work of only a few minutes, as you will sometimes hit it at the first, or at the most the second setting.

In this manner, I have set ten or twelve pickets in succession crossing a valley, which did not average over three chains apart, and by sighting on a reference object or back picket, have frequently found that the direction of the line had not changed more than two or three inches to the mile.

The advantages of this method are that it relieves the picketman from carrying a flag picket, which, to him at least, in a hilly, broken and mountainous country covered with timber, is a nuisance. It relieves the picketman also from placing a hub at each station.

It gives the surveyor the advantage of setting his instrument at the best point for producing the line, and therefore he has not to depend entirely on the point chosen by the picketman.

After the picket is set, it often occurs in wooded country, that a knoll or ridge intervenes between the point taken by the picketman, and the place best suited for the next station, which was not visible until the line was opened out. It, therefore, gives the surveyor an opportunity before setting up the instrument at the point intended, to move forward to the ridge or knoll, and line in from there.

Some surveyors, in taking short sights, use a chain pin set on a hub, instead of a picket. A surveyor, employed on the survey of the Railway Belt in British Columbia, told me that he was often surprised at the correctness of his own work, when producing a line up and over a mountain, where he had to take a number of short sights in succession on a chain pin, as above described. But to see a chain pin distinctly it is necessary to change the focus, which I never do, because in changing the focus you are very liable to change the line of collimation also, if the focussing tube has not been properly made, and does not move parallel to the line of collimation. It would never do to be constantly adjusting for focus and collimation. When the difference between the back and foresight is great, if you cannot centre the line of sight by having your eye close to the eye piece, move further away; by paying attention to this, the difference with or without focussing is hardly perceptible.

One disadvantage of this method is that the forward picket may be moved before the instrument is again set in line. This may be caused by the picketman when moving away from it, or by the surveyor himself when passing it, to set up the instrument for another sight. To avoid any change of position, the picketman should set the picket firmly in the ground, and remove all branches or loose stones away from it. As soon as the picketman leaves, another sight should be taken, to ascertain whether it has moved or not. In passing the picket, the surveyor will have himself to blame should he not make a sufficient detour to avoid moving it.

To say anything special to the older surveyors would probably be a waste of words, as years of practice have produced methods of working that will not likely be changed. If they have been careless in their operations, they will likely be careless still. A word to the younger members of the profession may not be out of place, and I have done. The time to be careful and precise is when starting out to work, "as the twig is bent the tree inclines." Every day, in the future, will demand more care and precision in the prosecution of surveys. If you undertake a survey, you must make up your mind to do it well, whether it pays or not. Remember that there is no line run, or post placed in error but will be discovered sometime, and although they may not bear witness against you, or effect your position, still they stand as monuments either of carelessness or ignorance. Continue your studies at every opportunity. It won't hurt you to be possessed of greater knowledge than your predecessors. "Knowledge is power," and may be a stepping stone, in your case, to an important position. When you are constantly employed in the practice of the profession the opportunities for study are only casual. On a survey of several months duration, with its attendant hardships and privations, you will not feel much inclined to study in the evenings after you have checked over the day's work. Besides this, you cannot carry a library with you, and your studies must be limited to a few subjects. Indeed constant practice is more likely to cause a loss, rather than a gain, in theoretic knowledge.

This is an age of progress, and sooner or later a more systematic and accurate survey of the Dominion will be made. In all lilkelihood it will be commenced at an early day, and successfuly prosecuted until we have a correct map of the whole Dominion. You may have a chance yet of employment on this survey, and should, while you have an opportunity, possess yourself of the knowledge that would fit you to undertake any part of the scientific or practical work required. If you are not willing to make an effort to reach the top of the ladder, better far to turn your attention to something else to obtain a livelihood, than to be a drone amongst workers, a careless operator, a producer of blunders and a disgrace to the profession. But whatever you decide to do let not carelessness or ignorace be laid to your charge, as an excuse for want of precision in your surveys.

JOHN McLATCHIE.

Ottawa, 17th February, 1889.

DISCUSSION.

The President—"Mr. McLatchie is to be congratulated upon his first effort. I have had a great deal to do with surveys in the North-West Territories, and corrections of the same, and I have realized that a large percentage of the errors, connected therewith, have been made in the first case and that after errors were in a large measure the result thereof. When suggestions of the kind contained in Mr. McLatchie's paper come before the Association, they deserve great attention and carry great weight."

WM. DREWRY—"I think Mr. McLatchie's standard is too fine for practical purposes and that contraction or expansion of the chain alone might cause errors of the dimensions referred to."

A. O. WHEELER—"Mr. McLatchie has made allowances for contraction or expansion"

Mr. DREWRY—"The standard of precision should be regulated by the class of survey being performed."

J. F. SNOW—"I am glad Mr. McLatchie has called attention to alignment. I think that the pay of a contractor on North-West surveys does not allow of his going over the work twice. I have found in contract surveys that the errors of subdivision nearly always result from bad alignment in the outlines. Under such circumstances a contractor should not be expected to do work of so high a standard, when the outline work could not be depended upon.

REMARKS ON A TRIP TO ALASKA AND RETURN VIA MACKENZIE RIVER.

I presume you are all aware of the fact of the journey referred to, and in a general way with its objects and results, at least the main features of them. I now propose to give a *resumé* of my official report, which will be printed and issued with the Annual Report of the Department of the Interior for the year 1889. In an official report one does not care to put many incidents, adventures and hardships which one has experienced, and the trains of thought which they start ; yet these are to the traveller, one might say, the only mementos of the occasion which are exclusively his own. His report of the condition, resources, topography and natural history of the country is public property in which he has no individuality more than the fact that such a discovery or determination was due to him, and if his discovery or determination is not worth to his fellow men more than ordinary attention, it is soon buried in oblivion, and in his connection with it when so buried, where is he ?

In the course of the following remarks I will assume that you, my professional brethren, are in sympathy with me, and that I have your attention over the whole route. I will further assume that you will unanimously acquit me of egotism throughout my recital. Mr. Klotz is down on our programme for an article on the " Railway Belt in British Columbia." It is a pity some other member did not give us a " Bird's eye view of our great prairie," and another a homily on "A road through the wilderness," which would complete a description of my entire route from and to home, and give us a somewhat more intimate acquaintance with the geography and topography of the greater part of our great Dominion, and when I say great I do not at all use the word in a satirical sense, but love my country enough to confidently look forward to the time when she will, through the development of her enormous resources, and more than that the cultivation and growth of a spirit of what I will call "Canadianism" in the bosoms of her sons and daughters, take her place among the factors of the world's improvement, and become the strong right arm of that Empire on which the sun never sets.

Many might suppose, knowing my residence, that the title of this paper conveys to them remarks on the route from Ottawa to Ottawa : I do not intend it to cover much more than a third of the journey. If any member feels aggrieved in consequence, I suppose he has legal recourse, and if he has money enough to employ the requisite talent will no doubt obtain his lawful rights, and the legal lore of the community be considerably enlarged and enriched at his or my expense, but then we will have the advantage of knowing just what a title means.

The part of the journey between Victoria and Chilkoot Inlet has been so much written of, talked of, and pictured during the past few years that I will only repeat one of the many statements made concerning it: that though it is in ocean water, and can be traversed by the largest ships, it is so sheltered by countless islands from the gales and waves of the vast Pacific, nearly the whole of the length, that its waters are always as smooth as those of a large river.

In marked contrast to this is the west coast of the United States, where harbors or shelter are like angels' visits.

My further remarks will refer only to that part of my route over which my professional work extended, some 2,700 miles.

My survey commenced at Pyramid Island, in Chilkat Inlet, the latitude and longitude of which were fixed by a party sent out by the United States Coast Survey to observe an eclipse of the sun, August 7th 1869. I made them the origin of my survey. I carried the survey over to Chilkoot Inlet at Haine's Mission; thence along the west side of Chilkoot Inlet to Taiya Inlet and up it to its head. The altitude of some of the highest peaks around the head of Taiya Inlet was determined by triangulation, and angles of elevation. The highest visible from Taiya Pass was thus determined to be 6,070 feet above a station of the survey, which was about 140 feet above high tide or about 158 above low tide.

A small river flows down Taiya Pass which is navigable for canoes to about six miles above the mouth; above this the current is much too swift and rough for boats, and everything intended for the interior has to be carried over the mountains on men's backs. The distance from the head of canoe navigation to Lake Lyndeman is seventeen and one-half miles; of these the first two (2) are comparatively easy, being clear of trees. About seven of the remaining nine (9) to the summit of the Pass are in heavy woods. Getting my two canoes through this was a slow, tedious job, which would seriously test any man's fortitude and christain forbearance. The river has to be crossed three or four times in the Pass, and as the water is ice cold and about three feet deep, it will never be resorted to as a bathing place. The lowest crossing is about thirty (30) yards across and the current is so strong that unless one has a load on his back he can hardly stand on his feet. The Indians when crossing carry a stout stick which they use as a prop while making a step. The women while crossing, tie their skirts up—modesty forbids me to say how high—and use their canes as dexterously as the men. Before my canoes came up to this point I had to cross twice; the second time while I was very warm after clambering down the steep side of a hill 1,360 feet high.

To people living in ordinary conditions this would seem dangerous, but I think most of us have, at one time or another, had many such experiences, and our health will compare favourably with that of any other body of professional men.

When one of my canoes came up I selected a quiet pool between two rapids, and started to put over such of my material and instruments as were at hand. While doing this a couple of miners came up with their packs on their backs and asked to be put over. One of them was a young man called "Mad Hank," the other was much older. I got them both placed in the canoe and started across, when Hank told me he was no "greenhorn" in a canoe and in proof of it stood up. I ordered him to sit down; he started to give me some of his canoe experience, to do which he found it necessary to face me, and began to turn round, but ended by trying to stand on his head in the river, upsetting the canoe as he went out. I managed to get on my feet in about five feet of water and clung to the canoe to prevent her going over the next rapid, where she would probably have been torn on the rocks and drift wood. The poor old man stuck to the canoe with all the tenacity of a drowning man. I had hard work to keep on my feet in the deep water, and in struggling with the canoe turned her completely over, the old man going under her and coming up on the lower side minus his hat. With much difficulty I put the canoe ashore at the head of the next rapid and hauled her out, the old man still clinging to her, and Hank on the shore looking on in a chilled daze.

The result of the circus was that they lost every thing they had in the canoe at the time, including 50 lbs. of sugar, a double barrelled gun and some tools. I had the discs for my base rod in at the time but as they were securely tied in their case, which would float them, they were picked up uninjured below the rapid.

I intended making some appropriate remarks to Hank but found they were all congealed within me by the cold water, besides he looked so thoroughly scared and rueful over the mishap that I laughed all my chattering teeth would at the time permit.

In keeping with his character he made the descent of the river as far as Forty-mile, where he mined for about three weeks, gave it up and started out with the first outgoing parties. I met him on his way out, and to prove to me he was wise in leaving, he told me that a man had been frozen to death the previous winter while wrapped in 14 pairs of blankets, and as he had only three pairs, he thought it useless to remain.

The edge of the timber on the South side of the pass is about 2,000 feet below the summit, or 1,400 feet above the sea. The distance from the timber line to the summit is about two miles, most of which is of uniform slope and not very hard ascend. About two-thirds of the distance up there is a very steep bit in which there is a rise of 500 feet in about as many yards. When packing over the pass the Indians, if they get to the timber limit during the day, remain there until about midnight, when the snow in the pass is frozen and they can travel over it with comparative ease. On the very steep place they cut holes in the crust with a small hand axe and help themselves up with their hands, otherwise with a heavy load on their back they could not get up this part. When the snow is soft, they use a stick, which they push vertically into the snow and pull themselves up by it.

The loads some of them will carry, and the small amount of food they will subsist on while doing so, would surprise one: that is if they are paid by the weight they carry. I had one hundred and twenty packs exclusive of my smaller instruments and canoes, which the party took over. These packs ranged from 40 to 146 pounds weight, and were carried by men, women and children, and all the food any of them had as far as I could see was dried salmon and a few biscuts. If you want to see the other side of their nature hire a few of them by the day and feed them, when the load that will absolutely double their limbs under them, and the amount of your food they will stow away will be in very striking contrast to the former quantities: but if you value your christian character and reputation as a gentleman don't do it.

I have read somewhere, of red snow being seen in this region; so it is, but it is only snow colored by a vegetable juice. When I first saw it I was surprised at the confirmation of the statement I have alluded to; but soon noticed that it was confirned entirely to the line of travel. This led me to examine it more closely, when I found it was caused by the juice of a berry which grows on a ground vine at the head of the timber limit. When pressed, this berry gives out a purple juice, which by dilution shades down to a pale pink. This juice is absorbed by the leather in the Indian's mocassins as he tramps on the berries, and afterwards stains the snow as he travels over it. This by the heat of the sun and the action of gravity on the hill side is distributed over a wide space compared with the track, and is visible after all sign of it is gone.

The red snow of the Arctic regions is in part due to vegetable coloring matter. Might not some of it come from a similar source?

The difference of elevations between the stations of the survey from the head of canoe navigation up to the summit of the Pass was determined from the distance between them and their zenith distances when referred to each other. In this way the summit was found to be 3,378 feet above the head of canoe navigation, which I assume to be 120 feet above tide water—Dr. Dawson sets it down at 124—this gives 3,498 feet as the altitude of the summit of the pass. Many of the peaks around rise upwards of 2,000 feet above this. From the summit to the timber limit on the north side is about six and a half miles, with a descent of about 800 feet. Lake Lyndeman is eight and a half miles from, and 1,354 feet below the summit of the Pass. This lake is five miles long and is separated from Lake Bennet by about ¾ of a mile of narrow rough river, with a total fall of 15 or 20 feet. Lake Bennet is at the head of navigation of the Lewes River, which from the head of the lake to the confluence with the Pelly is 375 miles, of which about 95 is lake. The westerly arm of Bennet Lake adds about 15 miles to this, and the lake called Takone Lake, known to the miners as the "Windy Arm" adds about as much more. Techo Lake is reported to be about 30 miles long, which gives us altogether about 155 miles of lake navigation in our territory; of this, Lake La Barge is below the Canon and rapids, and as it is 31 miles long, we have 124 miles of navigable lake on the head water of the Lewes River. In fact, with the exception of twenty-six (26) miles, all above the Canon might be called lake.

The Canon and rapids have been pretty well written up in several articles by several parties, all of them giving a more or less thrilling and dangerous character to them. From my standpoint of view the only danger in them is in the last few yards, and even that has been several times run through by parties in small boats—generally against their will however. That it is dangerous no one would deny, but that there is such terrible risk and such narrow escapes as are sometimes reported is a delusion. I do not wish to deny any man any credit he may be entitled to for running through it on a raft or boat, but what I wish to decry is : that any individual should consider and report himself a hero for having done something never before attempted and in comparison with which a descent of Niagara would pale, if we were to estimate the daring of the feat by the amount of bosh used in describing it. The fact is every one runs the Canon ; all who have heavy loads carry part of it over and run through light. The only danger is in striking the sides ; keep in the channel and you are safe, except your boat is very small. I admit the run through is exciting and a person who had had his fears aroused by reading some of the highly colored descriptions of it, more especially if he had no previous experience of the kind, might loose his head and run into danger, instead of out of it. The walls are perpendicular and high, and the channel narrow, and as you go through they seem to fly past you, which increases your fears if you watch them, but that is not what you are there for, your business is to watch the channel ahead, and keep in it. You can afterwards examine the walls much more comfortably from the top of the opposite banks.

The rapids just below the Canon are not at all bad. What constitutes the real danger to parties, who are not cautious, is a piece of calm water in the rapids, in which there is a short sharp bend in the river, which hides the last or "White Horse Rapid" from sight until you are in it.

Parties always examine the Canon and immidiate rapids before going through, and on coming to the calm water suppose they have seen it all, as all noise from the lower rapid is drowned in that of the one you are at.

On this account several parties have run through the "White Horse," being ignorant of its existence until they were in it. It is told of two young French Canadians, who got into it in this way, that they started to strip for a swim but before finishing thought it best to pray, and to their surprise found themselves safely trough before they had finished either. From the head of the Canon to the foot of the "White Horse" is a little over two and three-fourth miles.

Five rivers join the Lewes. The Tahk-heena, Tes-lin-too (called by Schwatka the Newberry) Big Salmon, Little Salmon and Nordenskiold. The Tahk-heena is reported to be navigable its whole length. It flows out of a lake which is said to be of considerable extent. The Tes-lin-too is the most important affluent of the Lewes, indeed it might be called the main river itself. If the different estimates of its length, can be relied on it must be upwards of a hundred miles longer than the part of the Lewes above it. It is reported navigable its entire length, which would give us uninterrupted navigation from Behring Sea to within a few miles of Taku River on the Pacific ; and only a few miles above its mouth. The estimated length of the Yukon, Yukon-Pelly, Lewes and Tes-lin-too is about 2,300 miles, over one-half of which flows through mountainous country ; yet it is all navigable, the only interruption being Rink rapids, called by the miners "The Five-fingers," and this might properly be called only a detention,as ordinary steamers could work their way up it with the aid of a line. It is only a few rods in length, and is 31 miles below the confluence of the Tes-lin-too and Lewes.

The Big Salmon, as it is described by miners who have been on it, is a river of considerable length, but is probably not deep enough to be navigable except for very light boats.

The Little Salmon is an unimportant stream, and the Nordenskiold seems of less importance.

The Pelly ranks as one of the main branches of the river; indeed if we follow the nomenclature of Robert Campbell, of the Hudson's Bay Company, the Pelly extends from the confluence down to the junction with the Porcupine. Mr. Campbell in 1840 discovered the Pelly near the head, and in 1843 he descended the river to its confluence with what he named the Lewes. Here in 1848 he built a post which he called Fort Selkirk, and in 1850 he descended the river to the mouth of the Porcupine, where in 1847 Fort Yukon had been built. He then ascended the Porcupine, crossed by Bells River to the Mackenzie and thus, for the first time, made the circuit from Fort Simpsom, by the Liard, Pelly, Porcupine, and Mackenzie, to Simpson again.

Between the Pelly and the International Boundary only two streams of any importance join the main stream, the White and Stewart Rivers. The White enters from the west side, 96 miles below the Pelly, and the Stewart 10 miles farther down on the east side.

The White was so named by Mr. Campbell on account of its very muddy water. It is of little importance as, though of considerable volume, its current is much too swift and there are too many shifting bars in it to be navigated.

The Stewart is a larger stream than the White, but I do not think discharges any more water, as its current is much easier. It is reported navigable up to the falls : about two hundred miles from the mouth, and one or two of its branches would add somewhat to the length of its navigable waters.

About 41 miles above the Boundary, Forty-mile River enters from the west. For purposes of navigation it is useless, only 23 miles of it are in Canada. With the exception of the Tahk-heena all of these streams are known to have more or less fine gold distributed in their bars and banks. The Stewart is called by the miners, good; the Tes-lin-too, fair, and the others indifferent. Gold is found on the main stream from a few miles below Lake La Barge down to and below the Boundary.

Coarse gold, the heart's desire of all placer miners, has so far only been found on Forty-mile River, but many spots where fine gold has paid well have been found both on the main river and the tributaries.

The pay has ranged from eight dollars ($8.00) per day up to thirty ($30.00) in the fine gold areas ; in the coarse, on Forty-mile, it has been as high, it is said, as $100.00.

Coal has been found at several points, prominently at Coal Creek near Forty-mile.

Silver-bearing galena was found on Forty-mile, and some silver-bearing rock near Fort Reliance, but none of it was specially rich.

All the country along the river, from the head to the Boundary, and along all its affluents, as far as could be learned, is mountainous, and it continues so upwards of a hundred miles below the Boundary where the country is said to be low, flat and swampy. The river here spreads out to several miles in width and is filled with islands. None of the mountains seen were more than 5,000 feet above the river, and but few of them were near that.

In a paper of a length suitable to the present occasion, no detailed description can be given of such an extensive region, and I will only say that the fauna and flora would not be found very different from that along, say, the Athabasca or Peace, the most apparent difference being in the size and luxuriance of the flora, which of course no one would expect to find so much farther north and at such a greater altitude equal to that of the more southerly districts mentioned. Lake Lyndeman is about 2,140 feet above sea level, and my barometer readings at the Boundary during the five months' stay there indicate a height above sea of about 800 feet, and it is pretty certain it is not less. From this we infer the height of all the region above the Canon to be upwards of 2,000 feet, an altitude in latitude 60 and above, incompatable with a rich flora.

The natives of the upper and river valley are few, and most of them, through long domination by the coast tribes, are spiritless and poor. Those of them who can make a trip to the coast with a few furs, have heretofore been often deprived of them by the Chilkoots or Chilkatts, often without any compensation, always at forced prices.

The coast tribes, in 1852, descended the river and pillaged Fort Selkirk, since when they have controlled the fur trade of all the upper river. Just now there are a couple of traders at the foot of Taiya Pass who, it is to be hoped, will better the condition of the interior Indians.

During the stay at the Boundary, all possible lunar culminations and occultations of stars by the moon were observed, to determine the longitude of the observatory and thence mark the position of the 141st Meridian (the International Boundary) on the river. I will make a few remarks on those observations at the conclusion of this paper.

Between 70 and 80 miners spent the winter of 1887-88 at Fortymile, 13 or 14 at Belle Isle, 12 miles below the Boundary, and 5, 22 miles below that. They frequently during the winter exchanged visits, and in doing so my house was a resting place for them, where they always timed themselves to remain over night.

Their visits were a great relief from the monotony of our lonely position. They belong to a great many different nations, reperesenting English, Scotch, Irish, American, French, Portuguese, Prussian, Austrian, Russian, Italian, and, last but not least, Canadian, which was more largely represented than any other.

All speak English or "United States," and very seldom is any other language heard among them. Nearly all of them are characters in their way and are capable of amusing themselves under conditions and in ways that we would consider utterly at variance with the idea of amusement. They are generous to a fault, and want does not go long unprovided for with them.

They have their own code of laws, which is principally based on a clear application of the principal of right and wrong in dealing with each other, and any party who should attempt to make wrong appear right would, I fancy, be judged more guilty than the wrong doer. Any party who has been wronged, or thinks he has, calls a meeting of the camp, which at once resolves itself into a board of trial and hears and disposes of the dispute. In all such trials a man's known character for truth and honorable dealing is an important factor in the case.

A culprit escaping on a technicality is, I think, unknown, and a party trying to bring such about would, I fancy, be punished more severely than the culprit.

All those I saw would hardly be admitted to church membership in the outside world, yet they might teach a lesson in charity and common honesty to many here who would consider them the dregs of society.

They were generally dreading the arrival among them, during the summer of 1888, of the professional gambler and thief, but had their minds made up to give them short shift if they came. All of them play poker for "dust," but the play is fair, and any attempts at "tricks" is at once discountenanced.

Playing cards and telling lies are their principal amusements in the long dreary nights. An island about a mile above Forty-mile on which about thirty of them dwelt was known as "Liars Island," and the residents the thirty liars. The author of "She" might with profit have spent a winter here. His fire of life would have been peculiarly welcome in the region. The transformation scene would not, I think, effect many there, as it did poor "Job," but would rather have been a source of amusement. To repeat any of the feats, adventures, accidents and other events invented for the nightly meetings of this club would take up too much time, and to convey an idea of their nature I refer you to the history of "Baron Munchausen."

Scurvey was prevalent in the camps in the early part of the winter, but its progress was arrested in February by the arrival of the Indians with large quantities of fresh meat. There were more than twenty cases of it at Forty-mile, only one of which proved fatal.

In my camp the members of the party enjoyed themselves fairly well reading, making the necessary articles for our trip to the Mackenzie, and out door exercise enough to keep the system in good working order. We had a slide down the side of a hill onto the river, on which there was much amusement. Occasionally in the evening a few games of cards were played, principally "poker," with beans for cash; some large sums were lost on these games. To one not accustomed to the monotony of such an isolated life, associated with the long night in the winter months, and the utter absence of knowledge of all the world and all that is near and dear to us, the loneliness is often oppressive. To be cheerful was a part of our duty, and all endeavoured to be so. I can personally say that much of the apparent cheerfulness was assumed, and often, in spite of all effort, a gloom would overcast all my horizon that would drive me almost desperate, and almost to the point of leaving my duty unfinished and making my way to civilization, or at least to where I could hear from home.

To convey my canoes, instruments, camps and other requisites, with provisions for the use of five men for five months, I had the party make 13 toboggans, and a double toboggan made after the fashion of twin sleighs on which the canoes were mounted for transport.

On the 3rd of March we started to reach the Mackenzie by way of the Tat-on-duc, Porcupine, Bells and Peel Rivers. The party hauled all the material to the mouth of the Tat-on-duc, about forty miles. Here Indians were met, whom I induced to aid me with their dogs as far as the height of land between the Tat-on-duc and Porcupine. They turned out with nine teams—36 dogs—and came as far as the head of the river, but nothing would induce them to go farther. The party had to cross the water-shed unaided. Thence down the Porcupine about twenty miles to where the descent was safe enough for canoes. Here a halt was made until the ice would break up.

I will now turn back and give a short description of the Tat-on-duc. It is a mountain stream which is unimportant in any sense as far as is at present known. It is only 60 or 70 miles long and falls about 2,800 feet in that distance. On the lower seven or eight miles the fall is much more rapid than farther up. In many places here the ascent is so steep that the water rises at the edges and overflows the ice and adds to its thickness until, it is in places, upwards of 20 feet thick, and presents the appearance of a hill.

The first Canon is eight (8) miles above the mouth. It is a chasm through a mountain 30 to 40 feet wide and 500 to 700 feet deep, the sides rising perpendicularly almost to the top. It lies at right angles to the valley of the river, and the mountains on either side of the valley, when seen from the middle of this narrow opening, present the appearance of mountains in a picture and add to the impressiveness of the scene. It is truly a grand scene !

The Indians conveyed to me as well as they could that the noise of the stream rushing through it in high water is like the noise of thunder. They can get near the lower end of it by clambering along the side of the hills, but it is difficult, and very few and far between are their visits to it, except in the winter. Above the Canon there is nothing worthy of particular notice until we come to Sheep Mountain (about 20 miles). This is apparently the highest peak in the valley ; near it the Indians described a small lake which they say never freezes, and the surface of which is constantly agitated by winds of such strength as to blow one over and into the lake if he stands near enough the edge of the basin, which appears to be very deep and steep. Afterwards, I more fully realized their meaning, when some distance above this, I came to a spot in the river where there was a large overflow of sulphureted hydrogen gas, which could be detected for several hundred yards along the river, and at one point is so strong as to make one sick. An Indian who was with me at this point made me understand that the wind at the lake was the same as this, and that it made men sick so that they fell in.

This simplified the existence of the wind at the lake which, accepting this as a fact, is nothing more than an immense escape of this gas which keeps the water in continual agitation and is concentrated enough all around the basin to kill any animal that may get into its area. They spoke of the skeletons of mountain goats and sheep being numerous around it.

When you have to get all your information by pantomime from people mentally constituted as Indians are, you all can readily understand a misunderstanding on both sides. I spoke of visiting this lake with some of them as a guide, but this aroused all their superstitious fears, and they solemnly warned me that I too would meet the fate of the animals that approached too near its brink, which they pictured to me rolling down the side of the basin and at last dying near the water or in it.

I noticed nothing in the appearance of the rocks around to warrant one in calling it the crater of an extinct volcano, which would be a simple explanation of the phenomenon.

A short distance above this we have to leave the valley of the river and go up the valley of a creek, or it might more properly be called a glacier. The ice in it must in places be nearly a hundred feet thick.

On the river a short distance above this there is a Canon in which there is a high water-fall, which renders it impassable ; hence the detour.

On the south side of the valley of the glacier a range of mountains rise about 2,000 feet, and end in an extensive table-land. On a part of the edge of this table-land an immense wall rises nearly a thousand feet above it. It is probably four or five hundred feet thick, and rises as far as could be seen, perpendicularly on both sides. It has been weathered into fantastic shapes, and is pierced by several holes, which can be seen through, to the hills beyond. What dimension of armament the builders of this mighty wall designed it for, I leave you to fancy.

About four miles up the valley we leave it to the north, and climb over a pass through the ridge between the valley of the glacier and the valley of the river.

The summit of this pass is about 700 feet above the glacier, and except on the summit it is all thickly timbered with spruce, tamarack birch and poplar of a size you would not expect at an altitude of 3,000 feet, in latitude 65° 20′.

On either side of this pass, tower two high bare peaks on whose sides numerous mountain goats could be seen cropping the scanty herbage. The peak on the west side of the pass I propose to name "Mount Deville," that on the east, "Mount King," and as in that region I was

> "Monarch of all I survey,
> My right there is none to dispute."

On the summit of the pass it is level for about half a mile. The descent on the north side to the Tat-on-duc River is steep for a short distance, and from the middle of the summit all view of the northern slope is shut out, and the scene is bounded, on the north, by the mountains on the north side of the water-shed. The evening I reached this spot the sky was all covered with dense white clouds, which bounded the horizon to the north, and the boundary between cloud and snow could hardly be distinguished. As I stood here gazing on this, to me, boundless view, with Mounts Deville and King towering to the clouds on either hand, I felt all the awe of a mortal who had been permitted to gaze through the gateway of time into eternity. I turned away from the scene with the impression that I had been favored as no other mortal ever was, and strange to say this delusion possessed my mind till next morning, when a cloudless sky, permitting a view of the far away northern peaks, dispelled the illusion.

The upper end of the Tat-on-duc river might be called a glacier, as I believe all the water which flows in it during the winter rises to the surface and continually adds to the thickness, until it must be over a hundred feet thick. In some places, the water rushes up through holes in the ice at such a rate that it cannot freeze until it reaches the surface: in this way hillocks are formed on the surface of the glacier, often 40 and 50 feet high.

Out of the basin in the mountains, which forms the water shed, three rivers flow, the Tat-on-duc to the Yukon-Pelly—the Porcupine to the Yukon—and a river which has been named by Mr. Johnson, Geographer to the Department of the Interior, "Ogilvie" River to Peel River. A peak at the head of "Ogilvie" River I have named "Mount Klotz."

The spring camp was made about 20 miles down the Porcupine, and during six weeks stay here the time was passed as comfortably as possible. Around us, on the mountain sides, roamed innumerable Cariboo and Moose. The former were so poor that they were useless as food, and we had not snow shoes large enough to overtake the Moose as the Indians do. To do this, you require a pair of very large size. When so equipped a man who can keep up a steady jog for 3 or 4 miles can tire them out in deep snow, when the rest is easy enough.

This camp was in latitude 65° 43′; longitude, approximately 139° 40′. The course of the valley from the camp is due north for about 16 miles, where it swerves to the right. Looking down the valley, a peak is seen which overtops all the others in the vicinity, and must rise over 4,000 feet above the river, or nearly 6,000 above the sea. I propose calling this "Mount Burgess," after our Deputy Minister.

About thirty miles from the camp, the mountains cease, their northern boundary extending nearly east and west from this point, which is in latitude 66° approximately. The last prominent peak close to the river is on the west side. The river sweeps around its base. It rises about 3,000 feet above the river, and is the most prominent object in sight from the valley, for many miles northwards. This peak I propose to name "Mount Dewdney," after the Honorable the Minister of the Interior.

The surface is hilly, and the descent in the river rapid for nearly forty miles from "Mount Dewdney," when the surface becomes nearly flat and all thickly timbered.

May 28th the ice broke up and started out, and we followed, after having to wait a day for a jam to break up and let us proceed. Going down the Porcupine this only caused delay, but going up Bells River it caused both delay, danger and hard work. By working hard day and night we reached La Pierre's House on the 6th June, after having lost a day going up Eagle River. A day was spent at La Pierre's House taking observations. Approximately the latitude is 67° 23′. On the 8th, the journey was continued up the river to McDougall's Pass through the Rocky Mountains, but so much drift ice was encountered that it was the morning of the 12th before the pass was reached, though the distance by the river is probably only forty or fifty miles, and the current is not strong. From Bells River to the summit of the pass is about eight and three-quarter miles, of which about six is got over on a very crooked creek, and the rest is lake. A great part of the creek and all the lake was still covered with ice, and all the outfit had to be carried over. Two prominent peaks, on the north side of the pass, I have named "Mount Dennis" and "Mount Russell," after two of our past Deputy Ministers.

From Summit Lake a creek flows eastward to Trout River, an affluent of the Peel. The length of this creek is about three and three-quarter miles, most of which was then covered with ice. The whole distance over which the outfit had to be carried was about 8 miles. The summit of the pass is about 1,200 feet above sea level.

On Trout River a descent of over 1,100 feet was made in 24 miles, and only 360 of this was made in the first 11 miles, leaving nearly 800 feet to go down in 13 miles; or over 60 feet per mile. This was always exciting, and often dangerous in our canoes, but the only mishap met with was occasionally to nearly fill them with water.

Fort McPherson, on Peel River, was reached, and preparations made to make a micrometer survey from that point up the Mackenzie to Fort Chipewyan, on Lake Athabasca, a distance of 1,400 miles. McPherson is in latitude 67° 26′—the highest point reached on the survey was 67° 47′. At McPherson, on the 21st June, I observed the sun's lower transit for time. It is needless to say that the time deduced from such a low transit was not very accurate. On the evening of the 22nd June the survey was started and continued without break to a point about 80 miles above Fort Simpson, or about 850 miles;

here low flat banks and very high water prevented any further instrumental survey, until Great Slave River was reached, by making it impossible to find ground dry enough to land on. The direction of the reaches of the river were now determined by compass, and distances estimated from the time and rate made on them. This makes a break in the instrumental survey of about 240 miles. All Slave River was instrumentally surveyed from the mouth to Chipewayan, where the survey was connected with the micrometer survey of the Athabaska, made in 1884.

This paper has reached such a length that very little space can be given to the Mackenzie River. By the course of the river, from the Arctic Ocean to Great Slave Lake is upwards of a thousand miles, nearly all of which is upwards of a mile wide. In this length there are only two rapids, but they are no impediment to navigation. On our way up, we paddled over one of them and did not notice it, the water being so high that even the current over it was not particularly noticable; this one is just above the Ramparts and about 10 miles above Fort Good Hope, which is about 310 feet above the ocean. The other, "Rapid Sans Sault," is 38 miles above this. It only extends half way across the river, and consists of a ripple over a ledge of rock which extends from the eastern shore to about the middle of the channel. On the western side no sign of a rapid is perceptible, and were it not for the noise no one would fancy anything unusual in the river. The Hudson's Bay Company steamer "Wrigley" passes up and down here, and finds less difficulty in doing so than in some other parts of the river. Along the river the country is undulating and covered with timber until we come to this rapid, where the surface is diversified by mountains, which approach to and recede from the river at intervals, up to near Simpson, a distance of nearly 400 miles; here they finally leave, or rather the river, by a sudden turn to the eastward, leaves them, and we see no more mountains on the outward journey until we approach Calgary.

On the afternoon of the 21st July, about 100 miles above Good Hope, I met the Hudson's Bay Company steamer "Wrigley" on her way down to McPherson. This is only an ordinary statement and does not arouse any feeling here, but to me that was no ordinary event—to me that little boat, with the grand old flag flying aloft, was *home*, and all that the word implies. For fourteen months I had been wandering in this dreary wilderness, unknowing and unknown, and now, in the form of that small boat, burst on my view, *home.* I have somewhere heard or read that Payne, who wrote "Home Sweet Home," had no home. Be this true or not as a fact, I can believe the idea is true, and that only those who feel the dreary aching void that nothing but home can fill, could compose and infuse so much feeling into so few words, otherwise why is the song so universally known and loved. It may seem strange, or you may as a class perhaps better understand my feelings at the moment, and pardon my weakness, but I could not restrain my tears.

I did not make any soundings in the Mackenzie, but the Captain of the "Wrigley" told me the shallowest water he found anywhere in the river was eleven feet, but that cannot be accepted as anything more than that the water happened to be that depth where he sounded—a few rods away it might have deen thrice that depth. The "Wrigley" runs between McPherson—there is nothing to prevent her going to the ocean if necessary—and Fort Smith at the foot of the rapids on Great Slave River, a distance of about 1,300 miles, of which about 140 are in Great Slave Lake.

The rapids at Fort Smith are about 16 miles long, and the total fall in them is about 240 feet. From the head of the rapids to Fort Chipewayan is over one hundred miles, of easy navigation for ordinary river boats. From Chipewayan shallow draught steamers ascend to Fort McMurray—185 miles, Above this the Athabasca is impassable for boats, by reason of numerous rapids which extend up to Grand Rapids, about 80 miles above McMurray.

Above Grand Rapids shallow draught boats can navigate at least 40 miles above Lesser Slave River, or 275 miles above Grand Rapids, and probably many miles farther.

My track, from McMurray out, was up the Clearwater River about 20 miles; thence overland to White Fish Lake; thence by a track never before travelled by white men to Lac la Biche. A rough survey was made of the track and it will appear on future maps of the district.

The language spoken by nearly all the Indians on the Mackenzie is the same as that spoken on the Porcupine and Pelly-Yukon, and so little difference is there, in the different dialects, that the Pelly-Yukon Indians have no difficulty in conversing with the Indians around Peel River. The number of Indians in our territority on both rivers, exclusive of Esquimaux, who properly belong to the coast, is about 4,000. Through the efforts of missionaries, some of them on the Pelly-Yukon, and all on the Mackenzie, are more or less civilized.

This paper has drawn out to a length I did not intend, yet I feel that I have not conveyed half what I wished to.

In conclusion, a few remarks on some of the work will not be out of place. The micrometer measurements on the Lewes, and Pelly-Yukon —when checked by latitude observation were 1 in 61 too long. On the Mackenzie it was somewhat more. In order to determine as closely as possible the longitude of a point near the Boundary, from which it was to be located, a programme, embracing some sixty occultations of stars by the moon, was arranged by Mr. King, Chief Astronomer of the Surveys Branch, to be observed by him at Kamloops, and by myself at or near the Boundary on the Yukon-Pelly River. Owing to bad weather, at my point, only one of these occultations was observed, and the two lunations through which the programme extended passed without my accomplishing anything.

I then turned my attention to every available method of determining the longitude, more especially moon culminations. This in the ordinary way consits of observing the meridian transit of three or four stars which transit nearly at the same time as the moon and are nearly of the same declination. From the known Right Ascension of the stars and the chronometer times of their transit, and the time of the moon's transit, its Right Ascension is inferred ; hence the longitude by comparsion with its tabulation or observed Right Ascension at some standard observatory, or well determined point.

The value of the result by this method depends largely on whether or not our line of colimation is exactly in the meridian, and as the stars observed are nearly in the same declination, the observation itself gives us practically no indication of how much error there may be in our azimuth.

It occurred to me that a just as simple, and much more certain method, would be to combine the ordinary form of observation of star transits for exact time and the moon's transit, and from the observations themselves deduce all the instrumental errors and apply them to the observed time of the moon's transit,

The arrangement was as follows :—Ten stars were selected succeeding each other in Right Ascension, about five minutes apart, and such that the moon transited about midway in the group. Four of these were of nearly the same declination as the moon, four as nearly zenith stars, as possible and two polar stars. The first half of the group and the moon were observed with the telescope clamp east. The telescope was then inverted and other half observed.

From this by the method of least squares the chronometer error, and azimuth and colimation error of the telescope, at the time of the moon's transit, are deduced and applied to it, so that its determined Right Ascension at transit of our meridian is certain within small limits of error, and of course the resulting longitude is just as certain.

Occultations require a long and tedious computation—or a graphic solution devised by Mr. King which much shortens and simplifies the work—before we observe, and a very tedious calculation, afterwards to deduce our longitude; besides we require to know our chronometer error at the instant of occultation very exactly, and we have one such programme of stars as I have described either immediately before or after occultation—or both is still better—to observe. We have then to deduce from these the chronometer error of the observed instant of occultation, and afterwards compute from the corrected time, as I before said, by a laborious calculation, the longitude. Now the method I advocate reduces the programme of observations to one, and all the preparation required is to select from a good catalogue of star places suitable stars, which you can do in a few minutes by inspection, and the resulting computation is vastly simpler and shorter.

It is curious that Mr. Klotz and myself, though each entirely ignorant of the other's views, and fourteen or fifteen hundred miles apart, each thought of and used this method.

Occultations would probably give more accurate results, but we must recollect that the limit of error of all astronomical methods of determining longitude is much too large for any purpose except a preliminary one, which is of more or less value as the number of observations is large or small. They will certainly never take the place of determination by star transits and electric telegraph. This being the case there is little use in splitting hairs over method, and as this method requires only an astronomical transit mounted in or near the meridian, and a chronometer, and reduces the labor and trouble very much, I would recommend it to any of you who may be required to make such determinations.

I had hoped to show, by way of comparison, the values of longitudes deduced from occultations at some standard observatory during a period of three or four months, and then show my results at the Boundary, but I have been so far unable to obtain the former. I give the results by the method described, and any of you who can obtain a series of values by occultations can judge the relative value of the methods; while doing so it must be borne in mind that of the 22 observations given only two were taken when the thermometer was above zero, 16 when it was below −30°, 9 when it was below −40° and 2 when it was −50°. The results are given in time west of Greenwich, those on the first limb being given first and those on the second limb afterwards. I would give those on the first limb the greater weight as they were taken early in the evening when my nervous system was in normal condition. Those on the second limb came on after midnight and in the morning when I was somewhat wearied sitting up.

	H.	M.	SEC.
1st limb...........	9	23	35.89
	"	"	24.19
	"	"	28.02
	"	"	23.73
	"	"	21.54
	"	"	27.32
	"	"	33.16
	"	"	29.15
	"	"	30.19
	"	"	27.50
	"	"	37.72
	"	"	30.92
	"	"	32.68
mean	9	23	28.92
probable error......			3.01

	H.	M.	SEC.
On 2nd limb.......	9	23	40.42
	"	"	44.18
	"	"	52.24
	"	"	46.07
	"	"	39.96
	"	"	45.44
	"	"	39.70
	"	"	44.87
mean	9	23	44.00
probable error......			2.81
mean of all........	9	23	36.46

On one occasion the moon was sensibly full at time of transit, and both limbs were observed. The results were :

	H.	M.	SEC.
	9	23	33·16
and	"	"	39 70
the mean of which..	9	23	36.43

is practically the same as the mean of all. Were the moon's altitudes for each observation given it would be noticed that the greater the altitude the greater the resulting longitude. In observing a high transit one is stooped and in an uncomfortable position ; besides I was so clothed that it was much more so than if in ordinary conditions of temperature. This may account for the difference with me, but whether any other observer would find the same or a similar difference is a question that can only be decided by trial. It might be, and probably would be found that with an instrument differently mounted I would find different results myself. To illustrate how little does make a difference, I will state that with the moon's mean rate of motion, an error of one-tenth of a second in its observed transit produces nearly three seconds in time error in the resulting longitude.

WILLIAM OGILVIE.

HYDROGRAPHIC SURVEYING.

In taking up the survey of an extensive coast such as the shores of Georgian Bay, the first or chief consideration is the scale on which the work is to be plotted.

This will be governed by the character of the shore, straight or indented, water deep or shallow, the object being to shew everything necessary for the mariner without being cramped for room.

Some old chart can generally be found to give an idea of the nature of the coast, and in addition will serve as a useful diagram for the arrangement of the beacons to be erected, as well as give an idea of the general lay of the land. For the outer coasts of Georgian Bay I have adopted the scale of one to one and a half inches to the nautical mile.

Surveys of harbours and narrow, shallow passages have to be plotted on larger scales.

Having determined upon the scale, the next thing is to find a place suitable for measuring a small base, and a good opportunity is afforded for this while traversing the coast in connection with the main triangulation.

By the time the latter is completed a selection must be made.

Before the members for this Association, to say that we do not waste our time over the measurements of elaborate base lines may sound very shocking.

It must nevertheless be confessed that if we can find a tolerably level spot such as a beach or the head of a bay, some 1,000 to 1,200 feet in length we consider ourselves fortunate, and a day's labour suffices to give us our base.

For an extensive geodetic survey for land purposes, I take it that the measurement of a base cannot be too elaborately done, but in a purely hydrographical survey we act on the principle, to fill in the detail of our work just so correct that the sailor, for whom the work is intended, can detect no error.

Should the Government of Canada ever undertake an elaborate triangulation of its vast territory, it would be good to leave secondary points along the coast at a distance of about five miles apart as opportunity offers. These stations the future hydrographical surveyor could pick up, and so, save himself the time of measuring a base and perhaps observing for astronomical meridian, latitude and longitude.

Having measured our small base, we proceed to throw as good a triangulation over our projected season's work as the natural features of the coast will permit.

As long a side as possible is calculated and from it the remainder of the stations are plotted.

During the season the latitudes and longitudes of two extreme points are obtained, and by means of these the chart is graduated in the winter in office. The astronomical distance calculated between these two extreme points determines the scale, and should agree nearly with the assumed scale obtained from the small base.

While the triangulation is being carried on, principally by the chief, his assistants are sketching in the coast line in the boats.

This consists in pulling from point to point with a patent log towing astern, the index on the rail of the boat, and offsetting by estimation the indentations when they do not exceed a distance of 100 yards. Over that amount a patent log distance is run from the original line.

Beacons made from the drift wood on the beach are erected about every half mile, and fixed by the main triangulation stations.

A theodolite is set up at all of these minor stations and lines taken to all the salient points, and depths of bays, to check the offsets on the coast line sketch. Any hill-tops, conspicuous falls or other topographical features are cut in. Angles of elevation are taken to the hills, the difference of level being calculated by this angle, and the distance taken off the chart, allowance being made for curvature and refraction.

As most of our bacons are near the water's edge, the height of the eye above the surface is readily measured.

The height of a hill is usually the mean of three or four observations from different stations.

These small stations also serve to fix the boat's soundings, and the inshore ends of the ship's lines, as well as the outlying dangers.

When the coast line is all sketched and all the stations plotted, the next and most important thing of all is to do the sectional lines of sounding, selecting the fine calm days for the boats, and the clear though perhaps breezy days for the ships.

The boat's lines are run about 200 yards apart and at right angles to the general trend of coast, unless the shore runs nearly east and west, or north and south, when the lines are run in these directions for appearance sake.

The boat soundings are run out to a depth of seven fathoms, or if the shore is very steep, to a distance of 400 yards. This gives the ship safe room to turn in changing her lines.

The officer takes away in his boat a small sheet of the points on the portion of the shore he is to sound. There is one here for your present or after inspection.

He also takes a sextant, station pointer, protracter, tracing paper and pencils not forgetting his pipe and baccy, if a smoker.

Supposing he is dropped by the ship near the outer end of the line he intends to commence on, he first ascertains his whereabouts by a couple of angles to three of his beacons and plots his position ; if on the line, well and good, if not he works himself onto his line, and with his boat stationary he takes from his plan the angle which his line makes with some one of his beacons, puts that angle on his sextant and makes a good mental note of the part of the shore the line strikes, pulling for it, keeping some stone, cliff, tree or log on the shore in line with some topographical feature in the back ground, as a peculiar tree, gap, fall or top of a hill.

An experienced eye will always detect *some* range, to check which, every sixth sounding is fixed and the position of the boat ascertained.

When all the sectional lines are transferred to the chart and the soundings inked in, the suspicious coasts are re-transferred back to the boat's board, as you see on the small sheet before you, and are especially examined for the shoalest spot.

This is a general outline of an ordinary trigonometrical coast survey ; but on some coasts, as the one we were on last year, viz : the north-east shore of Georgian Bay, there was not a level spot a couple of hundred feet in length to measure a base on.

I had therefore to select a couple of prominent spots mutually visible ascertain their latitudes by north and south stars, also the astronomical bearing and so calculated the distance, in this case about twelve nautical miles.

From this base I worked in the remainder of the stations. In calculating an astronomical distance, knowing the difference of latitude and astronomical bearing, I take the mean bearing for the angle and the difference of latitude for the side of a plain right angled triangle.

The seconds of latitude are brought to feet by multiplying by the number of feet in a second of middle latitude. If the difference of longitude is required the resulting departure is divided by the number of feet in a second of difference of longitude for the middle latitude.

This is a simple rule, and the results differ very little from those by the most elaborate spheroidal calculation. I have worked several examples by both methods, and for hydrographical purpose find no practical difference.

For the sectional sounding of a large shallow bank a long way off shore, we make use of two or three flag buoys. These are put down by the vessel a couple of angles being instantaneously taken by two officers to fix them. These can be fixed by sextant angles to points which from a small boat would likely be below the horizon. With these local stations, in the shape of buoys, the bank is soon sounded If the day continues fine the boats return to the ship, which is hove to in the vicinity, for a few minutes, the sectional lines of soundings are inked in and the boats return onto the bank once more to pick out the plums, in other words to find the shoalest spots which are indicated by the shallowest soundings on the lines. This done the buoys are picked up and new pastures sought.

Given a calm day, these floating beacons serve many useful purposes ; as, for instance, to get down the straight shore near Cape Rich, Owen Sound Bay, in 1888.

This piece of coast has nothing opposite it to make a triangulation of but sky and water and is surmounted by high land at the back.

No other way, therefore, was left to get the minor shore beacons down but by floating beacons in such places as we should have preferred seeing islands.

In regard to the excellent hydrographic work done by the Uni ed States surveyors, it is as well to mention that the methods adopted by the officers of each nation in sounding a coast differ. In my service we are taught to work on the one-man-do-everything principle.

As far as I know, the boat sounding of a piece of coast by the American surveyors would entail the services of three officers, perhaps four, two in the boat and two with theodolites at the shore beacons to fix the boat by intersecting lines at preconcerted signals. With us the one officer steers his boat, fixes his position, records his soundings, unassisted. We usually sound alternate times in the boats, keeping abreast of each other as well as we can.

It soon becomes evident then if one boat is off her line, as a boat 26 feet long presents quite an object at 200 yards.

If an officer has not had sufficient experience, or is not clever at estimating distances, he has the angle subtended by the other boat, which he can put on his sextant.

Two, or perhaps three, boats sounding together also adds cheerfulness to what sometimes would be a desolate scene, encourages a spirit of emulation among the crews, and in case of accident to one boat there is assistance at hand.

The ship's lines are run by the chief of the survey, assisted by one officer. These lines are from a quarter to half a mile apart, according to the depth. Every second or third sounding is fixed by a couple of angles and the ship kept as nearly as possible on the lines previously ruled.

In Georgian Bay, where there is very little current, with the error of the compass ascertained, a tolerably calm day and a good helmsman, keeping on the line is not a difficult matter. Where the depth does not exceed about 24 fanthoms the ship steams steadly on at about 5½ nautical miles per hour. The sounding machine, with a lead from 25 to 40 lbs. weight attached to it, is hauled out by a traveller, on a wire rope, to the bow of the vessel. It is detached from the traveller by a tripping line when a cast is wanted. The line travels through the hand of a man aft and at a depth of over twenty fathoms, the lead would be fifty or sixty feet astern of the vessel before striking the bottom. An experienced and attentive sounder easily notices the slacking up of the line, which is then brought to the steam winch and hove up.

The bottom of the lead being armed with clean tallow before each cast, the sounder's opinion of the lead being down is corroborated by the nature of the bottom brought up. The interval between the soundings is regulated by an ordinary time-piece with a second-hand.

With a level bottom of twenty fathoms, an interval of three minutes gives a distance of about a quarter of a mile. The soundings are carried off shore as far as the land-marks are visable.

When the soundings are all inked in, and the shoal spots examined, the vessel proceeds to run clearing marks, or ranges as the lake seamen call them, to lead clear of the shoals by daylight.

During the season, the valuation of the compass is obtained at intervals of ten or fifteen miles.

I fear this is a meagre and uninteresting paper, but my brother surveyors, here assembled, will easily appreciate the difficulty of delivering a treatise on a foreign branch of surveying in the short space of some twenty minutes.

If I have bored the members of this Society, I trust that your indefatigable Sec.-Treasurer will receive his share of censure ; for had it not been for his importunity I would not have inflicted myself upon you.

J. G. BOULTON,
Staff Commander, R. N.

In order to illustrate his paper Commander Boulton exhibited the boat's sounding sheets, on which the work is laid down while in actual progress ; also a chart of the season's survey, complete in every respect. and ready to forward to the Admiralty to be copied and printed for publication. These records of the survey were examined by the meeting with much interest.

THE RAILWAY BELT IN BRITISH COLUMBIA.

Looking over the statutes I find the following references to lands dependent upon the position of certain railways.

In the Statues of Ontario, 52 Vic., Chap. 35, Sec. 4, we find. :—

"Whereas the construction of colinization railways will promote the settlement, and increase the value of certain unsettled lands of the Province; and whereas it is desireable that a portion of the said lands should be set apart and sold for the purpose of forming a fund to recoup the Province in respect of moneys expended in aiding railways—there is hereby set apart for the purpose of being sold and the proceeds applied to form the fund aforesaid—a tract of land at least ten miles in width on each side of the lines of railways to which aid is granted, as aforesaid, or on each side of the lines of the said railways, as the same may be finally located and established."

It will be noticed in the above that the lands appropriated for railway purposes remain vested in the Government, that is, are not granted to the Railway Company, and furthermore that it is optional with the Government to extend the limits of such lands beyond ten miles from the railway, and hence there is no definite limit to the "railway belt" as we will find it to be the case in British Columbia.

In the contract and agreement made between the Dominion of Canada and the Canadian Pacific Railway Company, amongst other things the Company was granted 25,000,000 acres of land. 44 Vic., Chap. 1, Sec. 11, says :— "The grant of land hereby agreed to be made to the Company, shall be so made in alternate sections of 640 acres each, extending back 24 miles deep, on each side of the railway, from Winnipeg to Jasper House, in so faras such lands shall be vested in the Government,—the Company receiving the sections bearing uneven numbers......"

Although the above description lacks precision and accuracy yet its obvious intention is that the Company is to receive lands within 24 miles of the railway. The lack of precision alluded to is that as there will be very many fractional uneven numbered sections along the 24 mile limit, no provision is made for the grant thereof as fractional sections, although by another part of the same section the Government may grant lands outside of the 24 miles to the Company, in order to supply, or partially supply, any deficiency of the 25,000,000 acres.

In passing, the inaccuracy may be referred to: it is, in stating "in alternate sections of 640 acres each." This, according to our surveys, is an impossibility; better it would have been to have said, "in alternate sections of the system of Dominion Land Surveys."

But to return to the apparent limit of the 24 miles. By the subsequent part of the above section, the limit is practically obliterated, so that there can be no occasion for determining or establishing such limit on the ground.

The only definite limit of a railway belt in Canada, so far as known to the writer, is that of British Columbia.

We have in Article IV, paragraph 2, of the Convention between Great Britain and Russia in 1825, a belt (South-eastern Alaska) somewhat similar in its conditions to the railway belt in British Columbia, in "That wherever the summit of the mountains, which extend in a direction parallel to the coast, from the 56th degree of north latitude to the point of intersection of the 141st degree of west longitude, shall prove to be at the distance of more than ten marine leagues from the ocean, the limit between the British possessions and the line of coast which is to belong to Russia, as above mentioned, shall be formed by a line parallel to the windings of the coast, and which shall never exceed the distance of ten marine leagues therefrom."

By the Imperial Order in Council of May 16th, 1871, British Columbia conveys to the Dominion in trust "........not to exceed 20 miles on each side of said line" (railway line).

"Twenty miles on each side of said line" is a simple and unequivocal description of the railway belt; its demarcation on the ground, however, irrespective of mountains, is by no means so simple.

In 1885 and 1886 the Dominion Government had an accurate azimuth survey made of the line of the railway through British Columbia. This survey was adjusted to the astronomic determinations of latitude and longitude at Port Moody, Kamloops, Revelstoke and Field.

From this adjustment resulted the position of the railway with reference to the net of section, township and range lines of Dominion Lands projected over the railway belt, and hence the position of every point of the line of railway from the nearest section lines became known

For uniformity of descriptions of points, the north and east limits of section in which the point lay were used as reference lines, instead of the nearest section lines.

The foregoing furnished the data for the computation of the limits of the railway belt.

The first step in the latter computation was to ascertain the position, with reference to the system of Dominion Lands, of the extremity of the radius of 20 miles, extending from and at right angles successively to the courses of the railway, and at the beginning of each course.

From the azimuth of the chord of the line of railway was obtained the direction of the 20-mile radius. This was then resolved into its equivalents of latitude and longitude in terms of townships, sections and chains; and ranges, sections and chains respectively, due regard being had for the curvature of the earth.

From this long and tedious computation evolve a series of points referred to the co-ordinates of Dominion Lands. Many of these points will fall, however, inside of the railway belt, although distant 20 miles from the particular point of the railway line from which they have been computed.

The railway belt resolves itself into this: "that tract of land lying on each side of the line of railway, the distance from any point on the limit of said tract to the nearest point in said line of railway shall not exceed 20 miles."

When we take into account the curving of the railway, a little consideration will show that the extremity of a 20-mile radius at right angles to the railway will not necessarily give a point on the limit of the railway belt.

The railway belt is the area covered by a radius of 20 miles moving at right angles to the line of railway on each side thereof; but in following the various curves the radius is continually swaying backward and forward, in the general forward motion; thereby making complicated intersections on the limits of the railway belt.

These intersections must be computed ere surveyors can be sent to establish the limits on the ground.

There are very nearly 6,000 positions of termini of radii to be computed for the railway belt in British Columbia, corresponding to half that number of azimuth stations along the railway. As an illustration of how the position, in terms of the Dominion Lands, of the extremity of the 20 mile radius is determined, the following example is given: As data we have the position of the azimuth stations of the railway referred to the system of Dominion Lands.

BOUNDARIES OF TWENTY MILE BELT.

K = 1600 CHAINS.

Station.	Bearing of Radius.	K Cos Z	2nd Corr	K Cos Z –Corr.–	K Cos Z + Corr.–	K Sin Z
121	347°.86	1564.26	0.22	1564.04	1564.48	+ 336.30

The first step is to convert the 20-mile radius of given azimuth, column 2, into its equivalent in chains of latitude and longitude, columns, 3 and 7.

It is obvious that the latitude ordinate in the right angled triangle projects beyond the parallel of latitude passing through the extremity of the 20-mile radius when the azimuth of the latter lies between 270° and 90°, and when that azimuth lies between 90° and 270° (reckoning from north through east) the ordinate does not reach the parallel, hence a correction is necessary to bring the ordinate to the parallel. This correction to the parallel, marked Corr. in column 4, is obtained from the formula :

$$\text{Correction} = \cdot 00000196\ (\text{K Sin Z})^2$$

in which K = 1600 chains (20 miles)

Z = azimuth of radius.

Column 5 KCosZ–Corr.– gives the meridian ordinate to the north.
" 6 KCosZ + Corr.– gives the ordinate to be measured south.
" 7 KSinZ is made + when to the west, and – when to be east.

The following is an explanation of the nineteen columns of the Computation Sheet :

Column 1. Gives the number of the azimuth survey station on the line of railway.
" 2. Expresses in chains the meridian ordinate to the north.

TWENTY MILE BELT COMPUTATION—BRITISH COLUMBIA.

NORTH SIDE.

Station No.	K. Cos. z. —Corr. Ch.	T.,S.,Ch.	Station. T.,S.,Ch.	Q. T.,S.,Ch.	K.Sin. z. Ch.	Converg. Ch.	R.,S.,Ch.	Station. R.,S.,Ch.	Station reduced to Corr. Line.	Jog. Ch.	Station reduced to Corr. Line.	Converg. Ch.	Q. R.,S.,Ch.	Point in R.,S.,Ch.	RESULT.			
															S.,T.,R.	Mer.	Northing Ch.	Easting Ch.
121	1564.04	3-2-45.96	27-6-48.99	31-1-14.42	336.30	—1.13	0-4-11.17	18-0-22.01	18-0-21.88	67-16	17-5-36.03	—.01	17-5-36.02	18-3-47-19	4-31-19	5	14.42	47.19

of the 20 mile radius is determined, the following example is given: As data we have the position of the azimuth stations of the railway referred to the system of Dominion Lands.

BOUNDARIES OF TWENTY MILE BELT.

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formula :

$$\text{Correction} = \cdot00000196\ (\text{K Sin Z})^2$$

$$\text{in which } K = 1600 \text{ chains (20 miles)}$$

$$Z = \text{azimuth of radius.}$$

Column 5 KCosZ–Corr.– gives the meridian ordinate to the north.

" 6 KCosZ + Corr.– gives the ordinate to be measnred south.

" 7 KSinZ is made + when to the west, and – when to be east.

The following is an explanation of the nineteen columns of the Computation Sheet :

Column 1. Gives the number of the azimuth survey station on the line of railway.

" 2. Expresses in chains the meridian ordinate to the north.

Column 3 In this T., S. show the nearest number of townships and tiers of sections greater than K Cos Z – Corr., and Ch. shows in chains the excess of T., S. over K Cos Z – Corr.; or in other words, how far the northern extremity of K Cos. Z – Corr. is from the northern limit of the section in which the extremity or point is situated.

" 4. This gives the position in latitude, expressed in terms of the system of Dominion Lands, of the azimuth survey station on the railway. The S indicates the tier of sections, beginning at the south side of the township in which the station is situated, and the Ch. the number of chains it is distant from the north side of the tier of sections.

" 5. Is the addition (or subtraction) of the two preceding columns. If the sum of the chains is greater that 80.50, 80.50 must be subtracted and S reduced by one section.

" 6. Expresses in chains the easting or westing of the radius from the station on the railway.

" 7. Expresses in chains the convergence of meridians, obtained with argument—distance of Q from base line and argument K Sin Z.

" 8. Is the addition of the two immediately preceding columns, and expressed in ranges, tiers of sections and chains.

" 9. Gives the position in longitude of the station on the railway, in terms of ranges, tiers of sections and chains, west of the Initial Meridian of such tiers.

" 10. Is the position given in column 9 reduced on the meridian to the Correction Line intervening between Q and the station.

" 11. Gives the jog on the Correction Line at the reduced position of the station.

" 12. Gives the position of the station referred to the north (or south) side of Correction Line.

" 13. Gives the convergence of meridians for the distance expressed by chains in the last column to bring it to Q.

" 14. Is the addition of the last two columns and gives the position of Q in ranges, tiers of sections, and chains on the parallel of Q west from the Initial Meridian. The point Q is on the meridian of the station and distance from it K Cos Z ∓ Corr.

Column 15. Is the addition of columns 14 and 8, and gives the position (in long.) of the point or extremity of the radius on the belt limit.

In the example given, the interpretation of column 15 would be :—the point is distant from the Initial Meridian, measured west along the parallel of the point, 18 ranges 3 sections and 47·19 chains, hence the point is in the fourth tier of sections in Range 19.

We have now the position of the extremity of the 20 mile radius expressed in latitude by giving the number of townships and tiers of sections from the First Base Line or International Boundary, and besides, stating the distance in chains from the northern limit of the last tier of sections ;—and expressed in longitude by giving the number of ranges and tiers of sections from the Initial Meridian, and also the number of chains that the point or extremity of radius is west from the west limit of the last mentioned tier of sections. Hence nothing remains to be done but to combine these expressions and give the distinctive number of the township, of the range, and of the section of the system of Dominion Lands in which the point is situated.

The township number, as given in column 5 for Q, will be the same for the extremity of the radius ; the number of the range will be greater by one than the number of ranges given in column 15, for as the point is a certain number of ranges and sections west, it follows that it must be in that range of the Dominion Lands expressed by the number greater by one than the number in column 15.

The number of the section is found by knowing the horizontal and vertical tiers of sections in which the point lies, counting from the south and east of the township respectively.

Column 16. This gives the particular section, township and range in which the point or extremity of the radius is situated.

" 17. Is the Initial Meridian from which the ranges are numbered westward.

(The Initial Meridians, to which the railway belt of British Columbia is referred are the 5th, 6th and 7th, corresponding to the meridians of 114°, 118° and 122° west longitude respectively).

" 18 Is the distance of the point from the north side of the section.

" 19 Is the distance of the point from the east side of the section

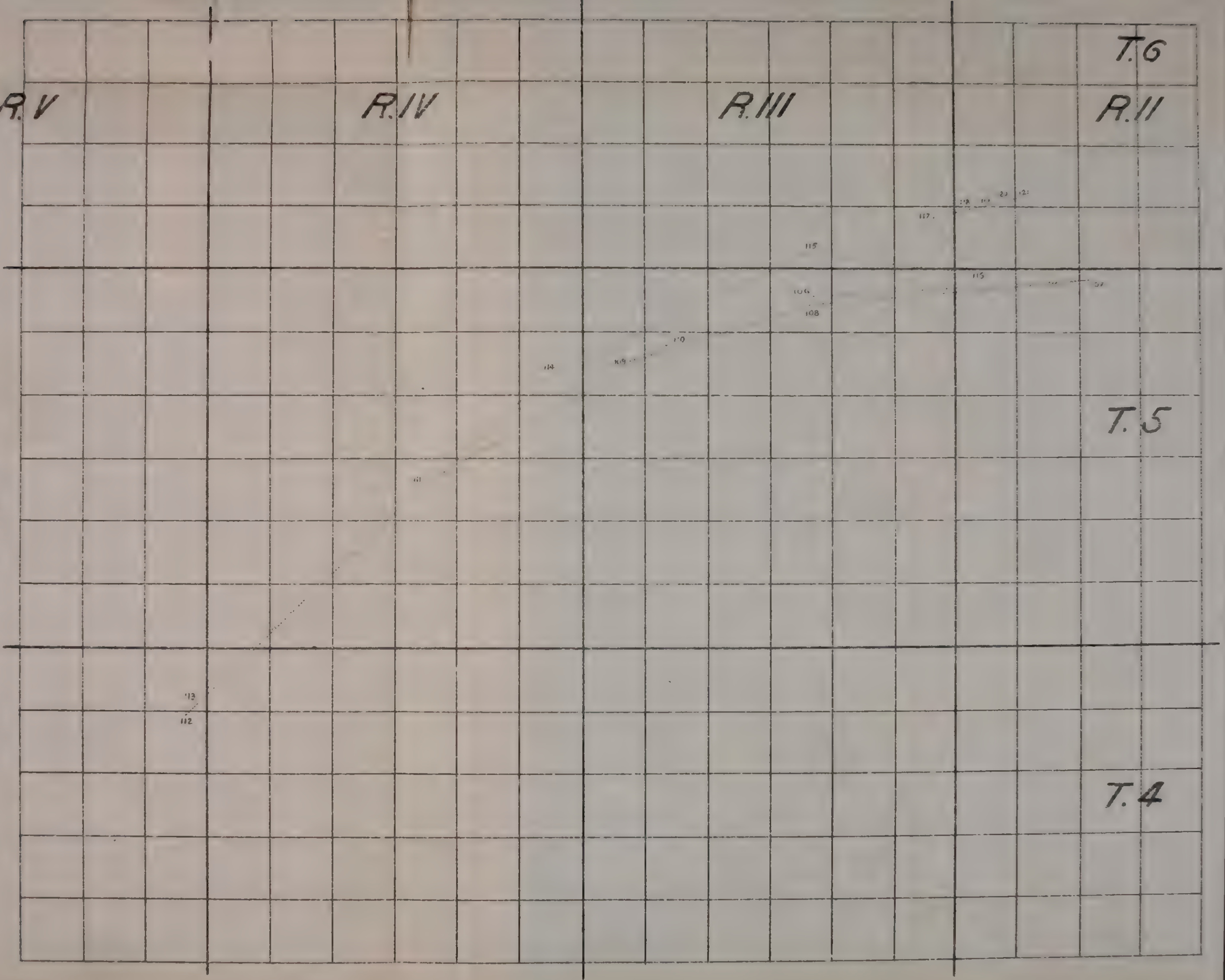

FIG. 1

Positions of termini of 20-mile radii from azimuth stations on railway.

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The computation of these 6000 points will occupy one person nearly a year. Thereafter, those points which fall inside of the railway belt, for reasons already pointed out, will have to be eliminated, and the intersections of the line, described by the extremity of a 20-mile radius moving at right angles to the line of railway, with itself be determined,

This will again entail considerable complicated work ere full data can be given to the surveyor for locating the limit of the railway belt on the ground.

There will undoubtedly be many parts of the limits of the railway belt in British Columbia impossible or at least impracticable to define on the ground from the mountainous character of the country, yet in the computation every point must be determined, as no *a priori* elimination of any point can be made. By careful plotting however on a large scale some prominent and obvious points, such as along The Loop in the Silkirks, can be eliminated from computation.

Figure 1 shows the position of the terminus of the 20-mile radius, on the north side of the railway, from each of the azimuth stations 106 to 121 inclusive. The lines joining these positions do not represent the path of the radius, but simply join the positions of the consecutive computed points, corresponding to the azimuth stations on the railway.

Figure 2* shows the path or line described by the end of the 20-mile radius or rather ordinate, moving along the chords of the railway as surveyed in the azimuth survey thereof. In that survey the railway is laid down as composed of finite chords, and hence the arcs described by the radius will be all of the same curvature, *i.e.* 20-mile radius, which will not be the case, as we shall see in Figure 4, when the curves themselves of the railway are considered.

In Fig. 2 the 20-mile ordinate moves at right angles to each chord on the railway; at the intersection of two chords it swings through an arc equal to the difference in azimuth of the two chords, and then moves again at right angles to the next chord, and so on.

This swinging of the ordinate causes the path described to intersect itself.

To find for instance such a point of intersection I (Fig. 2) we have given FF′ = FG, GG′ = GH, and the angle FIG′ = FGH, quantities all known from the railway traverse, hence

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* In Figs. 2, 3 and 4 the scale for railway is exaggerated compared with the 20-mile radius, so as to show to better advantage the intersections of the path of the ordinate with itself.—The dotted lines indicate the path.

$$IF' = IG = R \text{ Cot } \tfrac{1}{2} I$$

(I being equal to the difference in azimuth between the chords, and R = 20 miles = 1600 chs.) therefore $FI = FF' - R \text{ Cot } \frac{1}{2} I$.

It will generally be found that the point of intersection (I) falls behind F, that is on F′F produced, R Cot$\frac{1}{2}$ I being generally greater than any chord of the azimuth survey, whence

$$FI = R \text{ Cot} \tfrac{1}{2} I - FF'.$$

In the latter case the intersection of the tangents IF′ and IG falls *outside* of the 20-mile limit, as shown in Fig. 3 Hence the position of I′ on the limit must be determined.

IF becomes known as shown above.

$$\frac{IF}{FS = R} = \text{Cot } SIF$$

hence I′Io is known, being equal to I − SIF,

$$SI = \sqrt{(IF^2 + R^2)}$$

therefore in triangle I′IS are known the angle I′IS and the sides I′S and IS, whence I′I becomes known, and hence also the arc I′o, and similarly the arc FO.

Having the arc FI′ in angular measure with radius of 1600 chains, the arc is readily reduced to linear measure too, which gives us the desired quantity to measure from the known point F′, or from the preceding known position of E (Fig. 2).

Figure 4 shows the theoretic path described by an ordinate of 20 miles to the railway, following the curves and not the chords thereof as in Figure 2.

The 20-mile ordinate resolves itself into a radius of 20 miles ± radius of corresponding railway curve. This is obvious from the figure (4). It will be found that the path described by the extremity of the 20-mile ordinate, when equal to 20 miles minus radius of corresponding railway curve, will fall *within* the belt limit, and hence the curvature of the limit is that of a radius equal to 20 miles plus radius of corresponding railway curve. This holds too for the case of a tangent on the railway, when the radius will be infinity.

After the computations have been made as indicated, the necessary data for the surveyor in the field will evolve.

To define the belt properly its limit should be laid down as in

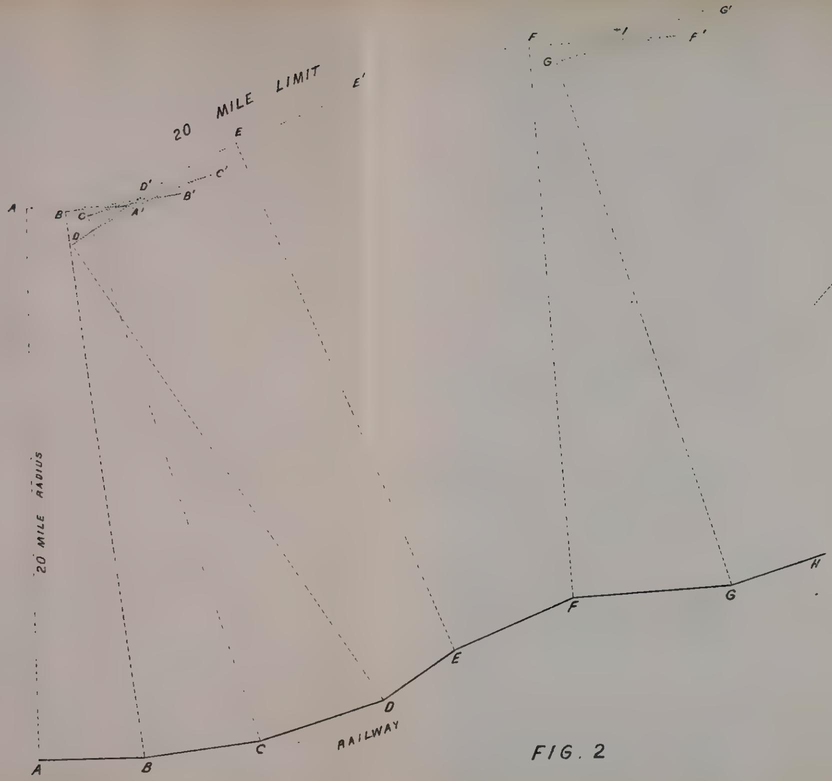

FIG. 2

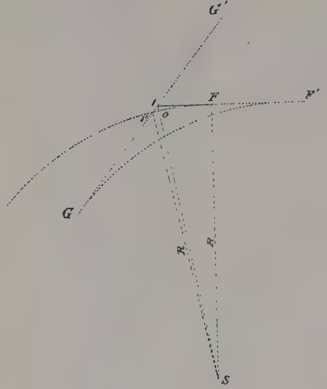

FIG. 3

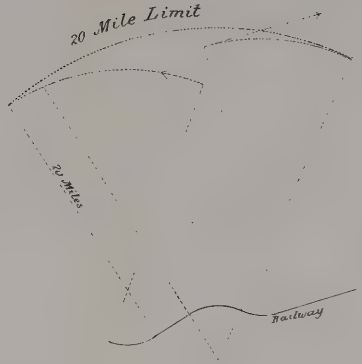

FIG. 4

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railway surveys, by drawing chords of the respective curves and for such distances as indicated by the furnished data.

The British Columbia Railway Belt has furnished, I think, the most intricate and longest computation that has so far occurred in connection with Dominion Lands.

OTTO J. KLOTZ.

[Mr. Klotz illustrated his paper by diagrams on the blackboard.]

PLANS AND FIELDNOTES OF SURVEYS OF DOMINION LANDS

MR. PRESIDENT AND GENTLEMEN,—

It was with some hesitation that I agreed to read a paper before you, not being able to add to my name the honorable letters "D.L.S." and therefore not being a full member of the Association. However, I have thought that a few notes on the subject of what we usually call "returns" might not be unacceptable. It has been my lot to see a good deal of the returns of Dominion Lands Surveys: in fact, I believe all such that have been made have passed through my hands, and in a large proportion I have had the task, not always a pleasing one to a sensitive mind, of hunting for mistakes.

When a survey has been made, there are two results, two records of it, remaining: one consists of the posts and other marks on the ground; the other is the subject of this paper, the plans and notes stored in the Department of the Interior. The latter is, I venture to think, the more important of the results of the survey, though surveyors who have come in after a long spell of hard work in the field are rather apt to undervalue the importance of the returns, and to look down upon office work as something that any fellow can do.

A few words as to other returns than the final plans and fieldnotes. The *sketches* sent in while work is in progress are valuable as giving early notice of just where surveys have been made, sometimes several months before the final returns are received and enabling us sometimes to improve maps that are about to be issued: and they also serve contract surveyors as a sort of account for advances of money, according to the rule so laconically expressed in the Manual of Surveys "No sketches, no money."

The first progress sketches were drawn on a scale of 4 miles to an inch, corresponding to the scale of the first maps of any importance shewing the surveys. When maps were issued on a six mile scale, the sketches followed suit, but this scale was altogether too small for the purpose. Of late years we have used forms on a one mile scale for subdivision, and two miles to an inch with four townships on one sketch for outlines. The latter it has been recently decided to abandon, so as to use one form for all surveys. This reduces the number of forms and makes them more easily kept in order when filed away, as well as giving the surveyor a larger scale to work on, which I think will suit him better.

A *timber report* is required for each township surveyor, in very many cases of course only to convey the negative information "No timber." The timber plans were found to be unnecessary, the printed plans shewing the position of bush well enough and giving more information of other kinds.

The *Statutory Declarations* obtained from settlers have developed from the old simple form into quite a catechism. They do not trouble me much, we pass them on for what they are worth, but I fancy the land agents must sometimes be puzzled over the answers. There are still one or two questions that could be added, such as that asked Artemus Ward "Have you had the measles? If so how many?"

The Forms of *Plans and Fieldnotes* have varied only in minor details since the surveys were established, and that so little change has been found needful is a standing tribute to the sound judgment and foresight of the late Col. Dennis, our first Surveyor General of Dominion Lands. The scale of the plans, the method of shewing road allowances with a heavy line on the side surveyed, the title of township plans, the table of contents, the colouring bush swamps, &c.—all these remain as first established and I think it would be hard to suggest any great change that would be an improvement really worth making.

The *Field-books* used for the first ten years were square books, somewhat uncomfortable for the pocket. The system of one section side to a page was adopted at once, and the rest of the form for field-notes has changed but little. The chief differences are that the depth of alluvial soil is called for and that the road allowance must now be ruled in instead of using the one column to hold the distances and represent the road allowance. This had the disadvantage that topography could scarcely be shewn on the road allowance without intefering with the figures for distances. The surveyor was supposed to shew which side of the road was run by ruling a thick line on that side; sometimes he did this, more often perhaps he omitted it. In 1881 a form of fieldbook for sub-division surveys was issued, having the headings of the pages all ready printed, the road allowances ruled in, the section numbers given at the sides of the pages and the skeleton index filled up. This at first sight appeared to be an improvement, but it turned out to be a great source of errors and trouble. If a township happened to be all prairie and the surveyor ran his lines in the order prescribed, it was all right: but there are a large proportion of townships where the order of running the lines cannot be adhered to, and even when it is possible, the surveyor often finds that he would lose much time by doing so.

The instructions for sub-division in the first edition of the manual gave this order for running the lines. In the first system of survey where the meridians are made parallel to the eastern boundary, there was perhaps more reason for begining at the N. E. corner of section 35 or the S. E. corner of 2 than in the later systems, but it was always hard to insist on a matter which was not of vital importance.

With the form of fieldbook I am speaking of, if the lines were run in any other order, or in different directions to those intended, endless confusion arose: the heading, the road allowance, the section numbers, all had to be altered. The consequence was that this form of fieldbook quickly disappeared and about the only trace left of this experiment in our present form is the division of the centre column by dots for the tallies. These dots certainly make the page neater, when there are but few notes to insert, and perhaps are an assistance to the chainman in remembering to enter the tallies; but when there happen to be many notes to enter within a few chains they are apt to be crowded together and made indistinct in putting them into the three-qurters of an inch allotted for ten chains of the line, and for this reason I have serious doubts whether they would not be better omitted. Another form of fieldbook which was but short lived was for outlines. It was rather clumsy to handle and had the page ruled in green squares, like section paper, with the intention that the topography should be sketched in approximately. This form could not be said to work well; it is hard, I suppose, to get a chainman who will take the trouble to plot carefully on the squares in the field, and I must say I should not like to have to do it when the flies were buzzing round in summer, or when the winter breezes were blowing. Anyone who has had to take notes with half frozen fingers knows that the simpler and easier they can be made the better.

Our present form for a page of field notes, the same for outlines as for subdivision, has this great advantage of simplicity; and "simplicity is the essence of perfection," a motto which has often recurred to my memory since I heard it from my first teacher in surveying, himself entitled to be called a D.L.S. though I doubt if he knows it, for it is thirty years or more, I believe, since he was in Canada. There is also a fieldbook with the alternate pages prepared for triangulation, data and corrections for slope and temperature of chain. These were for block surveys ; but the days of block surveys seem to have departed, perhaps never to return.

Now let me say a few words on one or two little matters in the fieldbook and the various ways in which they are put in.

The *class of soil* is entered as 1st, 2nd, 3rd or 4th. This is rather a rough way of estimating its value, and liable to considerable variation from the personal equation, so to speak, of different surveyors ; what is one man's 1st class is another's 2nd. Still I suppose it answers the purpose. Now and then we find attempts made to improve on it. One surveyor added a 5th class to express something worse than the worst ; this evidently destroys the value of the series ; we might go on then to class six and class four would become by comparison quite respectable. Another gentleman once inserted decimal fractions, such as class 2.5 or 3.7 but such refinement, I fear, is wasted ; it reminds me of the Hindoo musicians who they say can distinguish eight musical notes between two notes of our scale, though one would not expect such acute musical feelings from the sound of their toms-toms. Yet another gentleman gave some 0 soil in his notes, but whether this was rather superior to first class, as one versed in algebra might think, or whether it meant there was no soil at all, I am not able to say. Perhaps it is the equivalent of a description which occurs on one page of a fieldbook on record, " Land no good except for a fine view from the top of the hill." Land prospectors are not usually in search of the picturesque, and very likely the fine view is still open for settlement.

The *depth of alluvial soil* is, of course, only expected where pits have been dug, but it is sometimes entered "Through bush, through briar, through flood, through fire." I remember the depth of 48 inches of alluvial soil being given over a large extent of mostly timbered country and on the surveyor being questioned on the matter he maintained that he knew it was 48 inches everywhere.

The Manual allows certain *abbreviations* to be used in the fieldnotes and no others. This matter of abbreviations is occasionally a cause of trouble. It becomes wearisome to write the same words over and over, page after page ; it is necessary, however, that the use of abbreviations should be strictly limited ; the habit is apt to grow on one. After writing "Scattered tamarac" a few times, one feels inclined to reduce it to "Scat. tam." and further on in the book perhaps to "S.T.," but we must remember that a book of fieldnotes is not often read straight through, like you read your Bibles. It is frequently only one page that has to be referred to, and this page should be quite complete in itself and able to stand alone. We had before now to write and ask a surveyor what was the meaning of "B. and S. Will. Pop." The "S." has been known to pop certainly, but it turned out to be "Brush and shrub, willow and poplar."

We find in the office that the most fruitful source of errors is carelessness in copying the fieldnotes ; a very large part of the trouble with returns comes from this. I have heard such an expression dropped (in the days of 15 per cent. bonuses) as "I got them in in time anyhow, if there are mistakes I suppose you will find them." If a mistake is made in copying the notes and the plan is made to agree it is obvious that in many cases we cannot discover anything wrong. Allow me to suggest that the plan should be plotted from the original notes, not from the copy, or at least checked with the original notes before sending it in. Do not trust to your young friends, pupils or others, and think they will make returns all right for you ; they won't. A good look over the copied notes by the surveyor would save many an error which he has to correct afterwards and many also which now go on record and may rise up some day from their tombs in the Eastern Block, bringing trouble and discredit with them. The surest way of checking over a fieldbook is to take one thing at a time. Look all through the book at the headings of the pages to see that they are correct, then check them with the index. Look through again at the dates, again for the class of soil and so on. One of the commonest errors found is that different pages do not agree in the description of a corner, especially where there are bearing trees ; this, of course, is usually an error in copying.

One point on which it has occurred to me that we do not get nearly enough information is as to "High water marks." In a country like the North-West Territory it is of great importance to know, not only where water is now standing, but where it has been and may be again. A vast amount of trouble and expense would have been saved to the Government and to private persons if surveyors had taken the trouble to keep better record of old water lines.

The *Reports* are an exceedingly valuable part of the returns. The general reports sent in by outliners should give a description of each township side separately, giving the class of soil, 1st., 2nd., etc., so that these reports can be combined together to give some idea of the nature of a township before its sub-division and assist in making a fuller general description of the township after its survey. Many of these reports, as well as those of other surveys, are excellent specimens of what such reports should be; in some cases, however, there must be a good deal of useful information in the the surveyor's possession which he does not seem to think of giving to the world. Almost any facts that can be given may turn out to be of value, especially if the facts are carefully noted and precisely stated. It is very well to say a place is stony, for instance, but what sort of stones? It is all right to say there is plenty of water, but is it good water? In the mention of trees, brush, grasses and scrub, in the mention of rocks, boulders, gravel, etc., I think surveyors might often supply many more useful details than they do as a rule. It is not to be expected that every surveyor will be a botanist, but he should be able to distinguish between different species and varieties of pine, oak, poplar, etc., and give the country the benefit of his knowledge. If the scientific names of some of the trees could be given as well as their popular names it would add greatly sometimes to the real value of a report; the popular names vary, as you know, in different parts of the country. It is true that but few persons reading the report know any difference between one variety of a tree and another, but the scientific names being given would enable them at any time to be referred to those who do know for identification. It is not to be expected that every surveyor will be a mineralogist, but he might and should know the common rocks of the region he is working in and the ordinary minerals found their or to be expected, and he should have some idea of the geology too.

To come to *plans.* In 1872 when I entered the then recently established Dominion Lands office there were no blank forms for plans, and the work done in 1871 was represented in a very miscellaneous manner. I well remember the tedious business of replotting from the notes and making uniform plans, the road allowances, section numbers, titles, everything to be done by hand on each plan. This could not last long and by the next season we had blank township diagrams. These were at first printed in three forms, marked A, B and C, one for townships on a base line, another for those north of a correction line, and yet another for townships south of a correction line. It was soon found, however, that the variations in the lengths of lines on the forms due to unequal stretching of the paper would exceed the differences usually shown by the lengths found on the ground, and it was also difficult to get a surveyor to make the plan on the proper form where the difference was so slight. After that first issue the forms were made the same for all townships. It is by trying such experiments as this, rejecting those that turn out unprofitable and retaining those that are found good, that a system is gradually improved, and it is not, I think, altogether uninteresting to look back occasionally over the path we have come and review some of the abortive experiments.

Perhaps it would surprise some gentlemen to know the number of forms for township plans that are now in use. In the case of original township plans, for which we send the forms to surveyors, there are four varieties—old system, new system, British Columbia Railway Belt and New Westminster District, where the Provincial system is retained; but five other forms are needed in the office for compiling plans, and even then sometimes we cannot find one to suit. A great part of the plans now have to be compiled before they can be printed; in some of the townships in British Columbia the work of from six to ten different surveyors has been used on one plan.

The colors used are green for bush, blue for water, brown for brulé, yellow for swamp and red for cultivated land. In the office we use for bush Hooker's Green No. 2, which is a good color, easy to lay on and permanent on paper. On tracing cloth, however, the yellow ingredient runs after a time; on old tracings we often find that there is a slight tinge of yellow a long way round a patch of bush and what should be green has become pure blue. For water we use Prussian blue, for brulé burnt sienna, for swamps gamboge and for cultivated land carmine. These colors are all easily obtained, good to work with and transparent. Opaque colors, such as emerald green, are objectionable for our purpose, obscuring the printed lines and being hard to work over with a pen.

Roads are best shown by a double dotted line, this is generally unmistakable, but if they are shown by a single dotted line "Road" or "Trail" should be written on them.

Buildings are usually indicated by solid black specks, but these need to have "House," "Stable," or whatever it may be written against them; otherwise in the summer time a few able-bodied flies may add buildings to the township faster even than the gentlemen who are said to jump claims with portable residences. A railway is best represented by the well-known line crossed by ties; this should not be used, as it sometimes is, for a mere railway survey line found on the ground.

Hills can be shown best by etching with the pen, the top of the hill being made the heaviest part. To make them look well requires considerable practice at that sort of work, but I cannot suggest anything easier. Of course hill work can be done much more quickly with a brush (in sepia, neutral tint, or some other color) and if nicely done this suits very well for the plans we are speaking of, but it needs some skill and careful handling to work them in so as to agree with the notes and so that their meaning may be clear and they may not interfere with the areas or distances. Of course, if done in this way, the hills, as well as the rest of the coloring, must be put on before the plan is inked. When the hills are etched with the pen they ought to be done later on, so that the hills can be worked round the lettering and figures without confusing them.

As to the *lettering and figures* on township and outline plans, the first essential is that they should be distinct. Fancy lettering of any sort is out of place: good plain italics or "stump" writing are the great standby. There is nothing better for areas and distances, names of rivers and lakes and descriptions of soil, bush, &c.

I have just mentioned *descriptions of soil, &c.*, as being on the plans. In most cases one or two such remarks of only a few words, written across the plan or on seperate portions of it, give the general character of the country sufficiently. It is a waste of trouble to write small notes along the lines, showing slight changes in the nature of the bush or anything of that kind.

Everything on the plans ought to be intelligible without going to the field notes; dotted lines wandering about a plan when you cannot see what they mean are worse than useless. Nothing should be on the plans but what can be found in the notes, at least along the surveyed lines, but the converse of this that everything in the notes must be on the plans is by no means true; to show swamps a chain wide, or to distinguish small belts or clumps of different bush on the 40 chain scale confuses the plan without adding to its practical value.

If you compare one of our printed township plans with the original sent in by the surveyor, you will often find that though it agrees exactly on the lines actually surveyed, there is a good deal of connecting topography inserted between. For instance in your original plan you show the crossings of a trail on different section lines. We connect these when compiling the subdivision plan with the outlines if we think we can safely do so, making the plan more intelligible, especially to unprofessional persons who seldom understand how much has actually been measured on the ground. In the same way, if we find one creek running into a section and one running out, it is generally safe to assume that these can be joined, and if the creek has regular banks on each side wherever noted on the section lines it is highly probable that the banks continue across the sections. But if one creek runs in and two go out of a section, or two sections between the surveyed lines, we usually have to leave these loose ends where they cross the lines, not knowing how to join them. Now you could do this much better than we can, I was not there, but you were. You remember which way that creek goes ; you followed it for a short cut to camp that night the horse was lost ; you upbraided that creek for taking such a twist and making you late for supper. Now if you would look over your plan and sketch in some of these connections that plan will be a more accurate representation of the country, and therefore of greater value.

For *Plans of Township Outlines* we have used for some years blank forms the same size as those for township plans, giving 30 miles on one plan—a form for meridian exteriors, one for base lines and one for correction lines. These save a good deal of trouble and are much more convenient to handle and file away than the plans of all shapes and sizes such as we formerly received. Certainly a large plan, giving a whole block or more, gives a better general idea of the country, but the advantages of the small and uniform plans far outweigh any loss in this respect.

I have not yet mentioned the subject of *traverses.* The style of the fieldnotes for section lines is strictly defined, but for traverse notes the surveyor is left pretty much to his own judgment, and perhaps this is as well. The amount of traverse in a township varies so much, and also the nature of it, that an attempt to make the notes more uniform would possibly result in more trouble than it is worth. There is a great difference in the cases of section line notes and notes of traverses, copies of the former are often wanted by various persons, but the notes and plots of a traverse are rarely looked at again after they have been examined and placed on record. The deductions from them, shown by the shore lines, &c., and the broken areas on the plan of the township, are all that is generally wanted for further reference. The Manuel recommends, without insisting on it, that bearings, distances and offsets should be given in a separate table, and says they *need* not be marked on the plot. I should be much inclined, if it depended on me, to make the instructions read "*shall* not be marked on the plot." I think this way of showing them is a relic of barbarism, which is connected with the old practice of running a traverse as near the shore or other line to be surveyed as convenient and giving no offsets. It is difficult, especially if the courses are short, to give, without confusion, the bearings, distances and offsets, the distances on traverse lines to the offsets and to section lines, and the distances on section lines from corners to the traverses, and yet all this information is wanted. The tabular form is of course an improvement, but in my humble opinion far inferior to regular fieldnotes, with the distance placed in a centre column, the shore lines sketched in and offsets given in their proper sides. If this be done there is no difficulty in showing, when necessary, islands, buildings or other details, with as many offsets and as much description as is required to plot them properly.

There has been a great improvement in the notes and plots of traverses since the early Dominion Lands surveys, but still it is a part of the work on which a little more care would be very well expended. The last two or three courses often shew a feverish eagerness to reach their closing point which they would be spared if their predecessors had been a little more carefully plotted. It is a tedious job checking over long traverse plots at the best, and many a surveyor in want of funds who has grumbled at the time we spent examining his returns would have been merrily paid off long before if he had put this part of his work in better shape. I remember being rather puzzled once over a small lake traverse which, when plotted, sprawled all over the township with something the shape of a boomerang, only it never came back to the starting point as those weapons are said to do, it took a little time to discover that the chaining was continuous all round the lake, and the length I had taken for each course was greater than the sum of all the courses before it.

Liberty has been given the last four years to use a micrometer for traverses in subdivision work. Of this permission very little advantage has been taken, as far as I remember only one surveyor has ever sent in township work in which a micrometer had been used for traversing. Whether it is not so much saving of time and trouble as one would be inclined to think, or whether most surveyors are disinclined to use an instrument that is not very familiar, or what may be the cause of this probably most of you know better than I do. From my point of view the less micrometer work the better, the notes are awkward to check, especially as no two surveyors keep them quite in the same way ; and I do not think that the work will be found to fit in as well as that done with the chain.

I have touched only on the returns of regular surveys for laying out lands into townships and sections for settlement and do not propose to speak of the returns of extensive traverses and explorations of which so many have been made under intructions from the Surveyor General, nor shall I attempt to enter on the subject of mapping, though it is an important part of our office work, and is a natural result of our receiving the surveyors' returns. Already, perhaps, I have encroached too much on your time.

I will close these notes with the hope that I have touched some points of interest which may suggest remarks from some of the gentlemen present, and I trust that the hints I have thrown out will be taken in good part and that any mention made of errors and imperfections in the returns sent in to the Dominion Lands office will not be misunderstood as intended to cast any slur on the members of a profession for which I entertain the sincerest respect, and of the work to which my own is so closely related.

P. B. SYMES

DISCUSSION.

THE PRESIDENT—" Mr. Symes says that he is diffident about speaking before the Association, but I do not think any member is better fitted to make representations on this subject, and I am sure all such will be received in good part."

A. O. WHEELER, to Mr. Symes—" What is stump writing ?"

P. B. SYMES—" Italics with square tops, in distinction to italics with round tops. I do not know if the expression is used in this country. It is much more easy than the italics proper."

GRAPHIC SOLUTION OF SPHERICAL TRIANGLES BY THE GNOMONIC PROJECTION.

The object of this paper is to indicate a method of roughly solving spherical triangles by means of ordinary plotting instruments, without using logarithmic or other tables. Any projection or development of the sphere on a flat surface may be used for the purpose; for instance, in Chambers' Mathematics rules will be found for solving spherical triangles by means of the stereographic projection. The projection which I propose to use is the gnomonic projection, which has the advantage that all great circles are projected into straight lines, so that spherical triangles become plane triangles in the projection.

The gnomonic projection is made on a plane touching the sphere by straight lines joining the centre of the sphere with the several points whose representation on the plane is required. For the sake of simplicity one angle of a triangle can be taken as the pole—that is, the point where the plane touches the sphere. Then the spherical angle at this point will be the same as the plane angle, and the two sides of the spherical triangle which meet in this point will become sides of the plane triangle equal in length to the radius of the sphere multiplied by the tangents of the sides of the spherical triangle.

To measure an arc terminated by the pole.

Hence arcs terminated by the pole can be laid down on the projection by means of a scale of natural tangents, and conversely the arcs corresponding to a given line on the projection terminated by the pole can be measured with the scale.

Measure of any line.

Any line of the projection not passing through the pole can be measured in the following manner:—Let A B in Fig. 1 be the line (on the projection) which it is required to measure, *i. e.*, it is required to find the length of the arc of the great circle of the sphere joining the points on the sphere corresponding to A and B. Let C be the pole of the projection.

With centre C and radius equal to the tangent of 45° (as given on the scale of tangents) describe a circle. The radius of this circle is equal to the radius of the sphere; as this circle is used in all the constructions, it will be called, for the sake of brevity, the *unit circle.* Through C draw CE parallel to AB to meet the unit circle in E. Also draw CDF perpendicular to AB and cutting AB in D. With D as centre and DE as radius describe a circle cutting CD produced in F. Join AF and BF. The angle AFB, which may be measured either with a common circular protractor, or with a tangent scale, is the measure of the arc joining the points of the sphere corresponding to A and B.

Measure of an angle.

As stated above the angle ACB is the same in the sphere as on the projection. To find the spherical angle corresponding to the plane angle CBA proceed as follows (Fig. 1) :—

Let CB produced (if necessary) meet the unit circle in L. Draw CG perpendicular to CL to meet the unit circle in G. Draw LM parallel to BA to meet CG in M. Draw MN perpendicular to CM meeting BG in N. Then BN will be the tangent of the spherical angle corresponding to CBA, and the angle can be read off the tangent scale applied to the line BN.

By a reversal of this process the projection of a given spherical angle can be laid down.

Solution of triangles.

Hence, if from the three given parts, out of the six parts of a triangle, three sides and three angles, the projection of the triangle can be drawn, the other parts can be measured by the rules given above.

The problem of solving a spherical triangle is then reduced to the construction, from the three given parts, of the projected plane triangle.

There are then six principal cases, viz.:—

(1) Given the three sides.
(2) Given two sides and the included angle.
(3) Given two sides and an angle opposite to one of them.
(4) Given two angles and the included side.
(5) Given two angles and a side opposite to one of them.
(6) Given the three angles.

But since any one of the angles may be taken as the pole of the projection, and for particular reasons the choice of the polar angle may be restricted, there are several sub-cases; these are—

Case (2) If two sides and the included angle are given,
  (*a*) The included angle may be made the pole.
  (*b*) One of the other angles may be made the pole.

Case (3) If two sides and an opposite angle be given,
  (*a*) The given angle may be made the pole.
  (*b*) The given sides may be drawn from the pole, and the given angle may be one of the base angles of the triangle.
  (*c*) One of the given sides may terminate in the pole, and the

FIG. 1

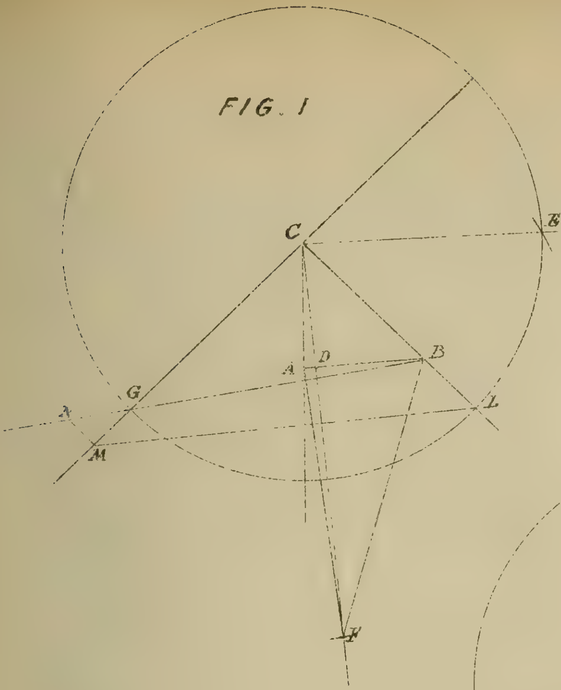


FIG. 2

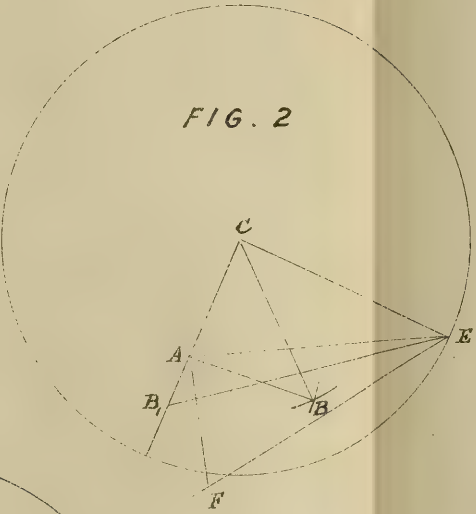
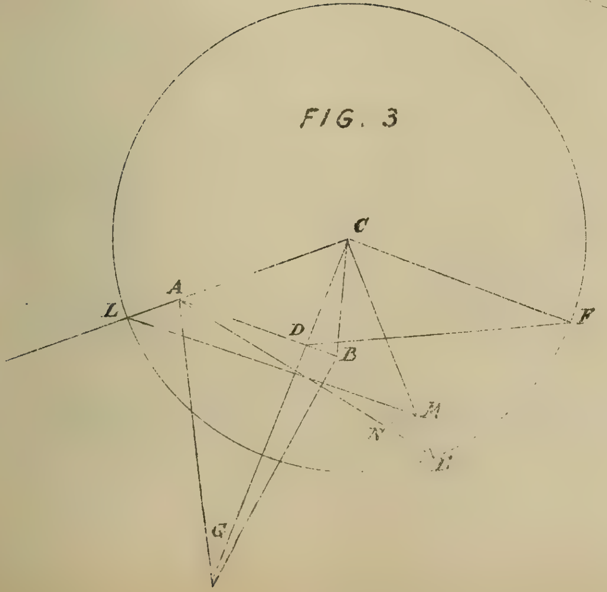


FIG. 3



Measure an angle.

Solution triangles.

other form the base of the triangle, and the given angle be a base angle of the triangle.

Case (4) Given two angles and the included side,
  (*a*) The given side may terminate in the pole.
  (*b*) The given side may form the base of the triangle.

Case (5) Given two angles and an opposite side,
  (*a*) The given side may terminate in the pole, and one of the given angles may be the polar angle.
  (*b*) The given side may terminate in the pole, and both the given angles may be base angles of the triangle.
  (*c*) The given side may form the base of the triangle.

There are, therefore, in all twelve cases affording as many interesting constructions. Two or three only of these constructions will be given here.

Case (1) Given the three sides, a, b, c, to find the angles. From pole C (Fig. 2) lay off along any line CA and CB, equal to the tangents of b and a respectively. Draw CE perpendicular to this line to meet the unit circle in E. Join EA, EB. Form a triangle EAF, having EA for one side, EF equal to EB, for another, and the angle AEF equal to C. With centre C and radius CB, describe a circle. With centre A and distance AF describe another, cutting the former in B. Join CB, BA. The triangle CAB is the prejection required and its angles can be measured by the above rules.

Case 2, (*a*) Given a, b and C, C being the pole. The construction here is obvious. Construct a plane triangle with sides equal to tan a and tan. b, with included angle C. This plane triangle is the required projection.

Case 2, (*b*) Given b, c and A, C being the pole. From C draw CA = tan. b, CA meeting the unit circle in L (Fig. 3). Also draw CE perpendicular to CL, also to the unit circle. On AE lay off AN = tan. A. Draw NM perpendicular to CE. Join LM Draw CF and ADB parallel to LM. Draw CDG perpendicular to AB. Join DF and make DG equal to DF. Join GA and draw a line GB making with GA an angle equal to C, and meeting ADB in B. Join CB.

CAB is the required projection.

The other cases may be solved by various devices. An interesting construction is that for the last case : given the three angles.

Applications—The first case, given the three sides, to find the angles, may be used to find the time from the altitude of a given star. As the angle may be measured to say a quarter of a degree, and this may probably be taken as the limit of accuracy of the construction, the hour angle may be found within a quarter of a degree, that is, the time within one minute, which is sufficiently accurate for many proposes.

By the case, given two sides and the included angle, may be solved the problem of finding the azimuth at any time. This may be applied in finding the declination of the needle of a pocket or prismatic compass, to say within a quarter of a degree.

This case may also be applied to finding the great circle distance (and the azimuth) between two points on the earth's surface, of known latitudes and longitudes, as for instance, the shortest distance between two ports. Here the perpendicular from the vertex on the base of the triangle is the complement of the highest latitude reached, and the shortest distance when restricted to sailing below a certain latitude may be found by drawing tangents from the terminal points to the circle representing that circle of latitude. In this case, if anything like a precise result is wanted, care must be taken to keep the error in construction small, as a quarter of a degree means fifteen nautical miles. Most of the other cases are more of theoretical than of practical interest.

Particular cases presenting difficulty—In the gnomonic projection, the lengths of lines rapidly increase as we recede from the pole, the equator being at an infinite distance. Therefore the construction becomes impracticable beyond seventy-five degrees or so from the pole, and hence frequently, as indicated above, we are restricted in our choice as to which angle to make the pole, for it will generally be convenient to make the two shorter sides meet in the pole.

When a side is greater than 90°, recourse may be had to the polar triangle, or to the supplimentary triangle formed by producing the sides of the original triangle to 180°.

W. F. KING

[Mr. King illustrated his paper by diagrams on the blackboard.]

Members' Record.

The following Record is submitted to the Association with an apology. The facts have been hastily collected, and the results are necessarily very incomplete, the names only of such members as replied to the circular of the 2nd of April last appearing. It is hoped with the next Annual Report to issue a full and complete Record, of which this is the initiation. Each member is responsible for the statements appearing under his name.

Secretary-Treasurer.

ACTIVE MEMBERS.

ABREY, GEORGE BROCKITT, D.L.S. and P.L.S. Ontario: *Practice*—General City Surveying and Civil Engineering. *Location and Field*—Cities of Toronto, Hamilton and vicinity. *Employment for year 1889*—Surveying: City work. Engineering: Roads, Sewers and Bridges. *Employment for year 1890*—Expects to be engaged as last year. *Professional Specialty*—Practice for the Courts.

BRADY, JAMES, D.L.S. M.E. and P.L.S. Ontario: *Practice*—Examinations, Surveys, Reports, &c., on Mineral Lands and Mines. *Location and Field*—Victoria and British Columbia generally. *Employment for year 1889*—Selkirk Mining and Smelting Co., Illecillewaet, B.C. (Silver and Lead Mine) Laura Hydraulic Gold Mining Co., Rock Creek, Okanagan Dist., B.C. Ophir Bed Rock Flume Co., Big Bend, Columbia River, Kootenay Dist., B.C. *Employment for year 1890*—Expects to be engaged as last year; also with Findlay Creek Hydraulic Mines; Thunder Hill Gold Quartz Mine; mineral exploration of the coast and islands of British Columbia, and the Glân Môre Brick, Tile and Terra Cotta Works. *Professional Specialty*—Mining Engineering.

BRAY, EDGAR, D.L.S. and P.L.S. Ontario: *Practice*—Local. *Location and Field*—Oakville, Ont., and Manitoba and the North-West Territories. *Employment for year 1889*—Township Outlines in the Lake Dauphin District, Manitoba.

BRAY, SAMUEL, D.L.S., P.L.S. Ontario, and C.E.: *Practice*—Surveying: Provincial Lands Surveys in Ontario. Dominion Lands

Surveys in Rainy River District, Ontario. Mining Surveys in Mexico. Engineering: Location and construction of railways in Ontario, Michigan and Wisconsin. Now permanently appointed as an Assistant Surveyor in the Technical Branch of the Department of Indian Affairs.

BROWNLEE, J. H., D.L.S. and P.L.S. Ontario and Manitoba: *Practice*—General Surveying and Engineering. *Location and Field*—Brandon, Man., and Western Manitoba. *Employment for year 1889*—Surveying: Dominion Government Survey of Townships 5 and 6, Ranges 31 and 32 W. of P. M. Engineering: City and Municipal improvements. Railway location. *Employment for year 1890*—Expects to be engaged on Dominion Government surveys; general Surveying and Engineering.

CHALMERS, T. W., D.L.S.: Inspector of the North-West Mounted Police, Battleford.

COZENS, JOSEPH, D.L.S. and P.L.S. Ontario: *Practice*—General Surveys. Geological Explorations and Mining Engineering. *Location and Field*—Sault Ste. Marie, Ont., and generally in District of Algoma. *Employment for year 1889*—Town Engineer for Sault Ste. Marie. Mining Surveys and Explorations. Promoting and obtaining charters for the construction of a railway from Sault Ste. Marie to Hudson's Bay, and making the exploratory survey of same. *Employment for year 1890*—Expects to be engaged re-opening Michipicoten Island Copper Mines; making geological surveys and explorations on line of Sault Ste. Marie and Hudson's Bay Railway. *Professional Specialty*—Mining Engineering and Surveying.

DREWRY, WILLIAM S., D.L.S. and P.L.S. Ontario: *Practice*—General Surveying and Engineering. Assistant Engineer on Central Ontario Railway on preliminary and location surveys. Assistant Engineer on construction of dam and combined highway and railway bridge across the Trent River at Trenton, Ont. Surveys in the North-West Territories and photo-topographical surveys in British Columbia. *Location and Field*—Belleville, Ont., and Hastings, Prince Edward and Northumberland Counties, Ontario, the North-West Territories and British Columbia. *Employment for year 1889*—Preliminary triangulation of Railway Belt in the Rocky Mountains to establish initial points of departure for detail surveys. Established a number of points contiguous to Bow Pass in the Rocky Mountains. *Employment for year 1890*—Expects to be engaged on the continuation of the triangulation of the Railway Belt. *Professional Specialty*—Photo-topographical surveying and mountain triangulation.

DUFRENSE, J. I., D.T.S. and P.L.S. Quebec: *Practice*—Dominion Government Surveys. *Location and Field*—St. Thomas de Montmagny, Que., and Manitoba, the North-West Territories and British Columbia. *Employment for year 1889*—Township Outline Survey on the North Shores of the North Branch of the Saskatchewan River between Battleford and Prince Albert.

DUFRESNE, L. ACHILLE, D.L.S. and P.L.S. Quebec: *Practice*—Local Surveying. Dominion Lands Surveys and Quebec Government Surveys. *Location and Field*—Dufresne Mills, Que., and Quebec and North-West Territories. *Employment for year 1889*—Observer of angles on the Triangulation Survey of the Railway Belt in the Rocky Mountains to locate accurately the points of reference in connection with the Topographical Surveys. *Employment for year 1890*—Expects to be employed in the North-West Territories.

FITTON, CHAS. E., D.L.S. and P.L.S. Ontario. *Practice*—General local work. Exploring and survey of mines. *Location and Field*—Orillia, Ont., and County of Simcoe. *Employment for year 1890*—Expects to be engaged exploring in Algoma for minerals. *Professional Specialty*—Location and survey of Mines. Valuations and estimates of Timber Limits.

GORE, T. S., D.L.S. and P.L.S. Ontario: *Practice*—Land surveys in British Columbia. *Location and Field*—Victoria, B.C., and principally along the coast from Victoria to Alaska. *Employment for year 1889*—Exploration and survey of coal lands on Queen Charlotte Islands; very satisfactory results. *Employment for year 1890*—Expects to be engaged on work similar to last year.

HENDERSON, WALTER, D.L.S.: *Practice*—Surveying: Laying out Town Lots and subdividing Pre-emption Claims. *Location and Field*—Chilliwhack, B.C., and New Westminster District and vicinity. *Employmeut for year 1889*—Surveys of Pre-emption Claims and Town Lots. *Employment for year 1890*—Expects to be engaged on surveys of Town Lots; Subdivision of Farms; timber Limits and Drainage Surveys.

IRWIN, HENRY, D.L.S., B.A.L.C.E., Trinity College, Dublin, P.L.S. Quebec: *Practice*—1872 to 1874, Assistant County Surveyor. Antrim Co., Ireland. 1874 to 1887, Assistant and afterwards manager to J. Rielle, P.L.S., Montreal. 1887 to date, Assistant Engineer, Canadian Pacific Railway, at Chief Engineer's Office, Montreal. *Employment for year 1889*—Assistant Engineer and Provincial Land Surveyor in neighborhood of Montreal. *Employment for year 1890*—Expects to be engaged as last year.

JEPHSON, RICHARD JEREMY, D.L.S. and P.L.S. Ontario and Manitoba; *Practice*—Local Surveying and Surveys of Timber Limits. *Location and Field*—Portage La Prairie, Man., and Counties of Russell, Silver Creek and Shell River, Man. *Employment for year* 1889—Construction on the Manitoba and North-Western Railway and local work in the Counties of Russell and Shell River. *Employment for year* 1890—Expects to be engaged on local work. *Professional Specialty*—Exploration of Timber Limits.

KIRK, JOHN ALBERT, D.L.S. and P.L.S. Ontario: *Practice*—Local Surveying and Engineering. Dominion Government Surveys in Manitoba, the North-West Territories and British Columbia. *Location and Field*—New Westminster, B.C., and British Columbia. *Employment for year* 1889—Fixing the boundaries of a portion of the Railway Belt in British Columbia by traversing Harrison River and Lake. Subdivision of lands in the Valley of Stave River, and traverse of Islands in the Fraser River for settlement purposes. *Employment for year* 1890—Expects to be engaged on surveys common to a general practice.

KLOTZ, OTTO, J., D.T.S, C.E.: *Practice*—Astronomic work. *Location and Field*—Preston, Ont., and Pacific Coast. *Employment for year* 1889—Astronomic work. *Employment for year* 1890—Expects to be engaged on Astronomic work. *Professional Specialty*—Astronomic work.

MURDOCH, WILLIAM, D L.S., Deputy Surveyor of Lands, New Brunswick, C. E.: *Practice*—For past twenty years employed on the Sewerage and Water Supply of the united cities of St. John and Portland. General practice as a Civil Engineer and Land Surveyor. *Location and Field*—St. John, N.B., and Province of New Brunswick. *Employment for year* 1889—Surveying: Engaged upon the plans and descriptions required by the Commission appointed under an Act of the Provincial Legislature to arrange terms of union of the cities of St. John and Portland. Engineering: Planned a system of sewerage for the District of Carleton and executed 6,690 feet of sewers, varying in length from 60 feet to 1,065 feet, distributed over the united cities. *Employment for year* 1890—Expects to be engaged on sewerage work and water supply extensions in the city of St. John. General survey work in the city, county and elsewhere. *Professional Specialty*—Sewerage and Water Supply, together with other branches that come under the head of Hydraulic Engineering. The design and construction of Parks and Cemeteries. Disputed boundaries of land in the city and county.

MCAREE, JOHN, D.T.S. and P.L.S. Ontario: *Practice*—Local surveys, City of Toronto. Dominion Government surveys in the North-

West Territories. *Location and Field*—Toronto, Ont., and City of Toronto, Manitoba and the North-West Territories. *Employment for year* 1889—Correction and Inspection Surveys in Manitoba. Laying out Lots for the Half-Breed Settlement at Pine Creek, Lake Winnipegosis. *Employment for year* 1890—Expects to be engaged on Subdivision Surveys in Manitoba.

McArthur, J. J., D.L.S. and P.L.S. Quebec : *Practice*—1879 to 1880, Subdivision Surveys in the North-West Territories. 1881 to 1886, Survey of Meridian Exteriors, Base Lines and Exploratory Surveys in the North-West Territories. Since 1886, engaged on Topographical Survey of the Rocky Mountains. *Location and Field*—Ottawa, Ont., and North-West Territories. *Employment for year* 1889—Photo-topographical Survey of the Rocky Mountains. Contour map of country covered by survey (covered 350 square miles). *Employment for year* 1890—Expects to be engaged on Photo-topographical Survey. *Professional Specialty*—Mountain Triangulation and Photo-topography.

McLatchie, John, D.L.S. and P.L.S. Ontario and Quebec : *Practice*—Local Surveys. Surveys of Timber limits and Mining locations. Dominion Government Surveys. *Location and Field*—New Edinburgh, Ont., and Quebec, Ontario, Manitoba, the North-West Territories and British Columbia. *Employment for year* 1889—Township Outline Surveys in the North-West Territories. *Employment for year* 1890—Expects to be engaged on Township Subdivision in the North-West Territories ; timber limit surveys and local practice.

Niven, Alexander, D.L.S. and P.L.S. Ontario : *Practice*—Chiefly local surveying. *Location and Field*—Haliburton, Ont., and Ontario. *Employment for year* 1889—Outlining Townships head of Lake Temiscamingue. *Employment for year* 1890—Expects to be engaged on Township Outlining at Lake Temiscamingue. *Professional Specialty*—Adjustment of disputed boundaries.

Patten, T. J., D.L.S. and P.L.S. Ontario : *Practice*—Surveys of Mining and Mill locations. Disputed boundaries. Retracing original boundaries. Survey of water fronts for wharves, etc. Subdivisions in Villages and Towns. Defining Timber Limit boundaries. *Location and Field*—Little Current,Ont.,and Manitoulin Island and mainland opposite. *Employment for year* 1889—Survey of Thessalon Town Plot under instructions from the Indian Department. Survey of flooded lands on the Blind River. Defining the north and east limits of Timber Berth No. 188 and north limit of the Township of McGivern, north shore of Lake Huron. Location of some important mining claims. *Employment for year* 1890—Expects to be engaged on Drainage work on the Manitoulin

Island ; location of Mining Claims, etc. *Professional Specialty*—Drainage. Disputed boundaries. Writing descriptions. Exploring for Timber and Minerals.

PEARCE, WILLIAM, D.L.S. : *Practice*—Superintendent of Mines within Dominion lands. Member of Dominion Lands Board. *Location and Field*—Calgary, and The North-West Territories and British Columbia. *Employment for year* 1889—See Report of the Department of the Interior.

SEWELL, HENRY DE Q., D.L.S., P.L.S. Ontario and M. E. : *Practice*—Surveyor to Municipal Council of Neebing. Mining Engineering Surveys of Mining locations. *Location and Field*—Port Arthur, and Thunder Bay and Rainy River District. *Employment for year* 1889—Survey of the Township of Scoble. Re-survey of part of the Towship of Paipoonge. Mining surveys and survey of Mining locations. *Employment for year* 1890—Expects to be engaged on Mining surveys ; surveys of Mining locations and sale of such properties. *Professional Specialty*—Mining Engineering, including the underground surveys of Mines. Surveys of Mines and Mining locations. Reports on Mineral properties.

WHEELER, ARTHUR O., D.L.S. and P L.S. Ontario and Manitoba : *Practice*—1880, Local surveys. 1881 to 1883, Township subdivision and Town Plot surveys. 1883 to 1885, Township Outline and Subdivision Surveys for the Dominion Government. 1885, appointed on Staff of the Technical Branch of the Department of the Interior. 1887, permanently appointed and attached to the Timber, Minerals and Grazing Lands Office of the same Department.

VICARS, JOHN, D.L.S. and P.L.S. Ontario : *Practice*—Dominion Government Surveys. *Location ond Field*—Cannington, Ont., and British Columbia. *Employment for year* 1889—Location of the Railway Belt in British Columbia from Hope to the Pacific. Traverse of Coquitlam River and Burrard Inlet.

ASSOCIATE MEMBERS.

McEVOY, JAMES, B.A.Sc., Geological Surveyor : *Practice*—Two years topographical surveying in Cariboo District, B. C. One year exploration survey in Yukon District. Two years Geological and Topographical Surveying in Southern Interior of British Columbia. *Location and Field*—Ottawa, Ont., and British Columbia and the North West Territories. *Employment for year* 1889—Assistant to Dr. G. M. Dawson in Geological and Topographical Survey of the Southern Interior of British Columbia. Map of area 80 miles square. *Employment for year* 1890.—Expects to be engaged on continuation of last year's work. *Professional Specialty.*—Topography in connection with Geology by panoramic sketches, with transit for azimuths.

ODELL, C. M., C.E. : *Practice.*—Since 1879 employed on location and construction of railways in Canada. *Location and Field.*—Truro, N.S., and Nova Scotia. *Employment for year* 1889.—In charge of 14 miles of construction on Cape Breton Railway including some heavy bridge work, steel trestling,etc. Grading, laying of rails and ballasting on said railway. *Employment for year* 1890—Expects to be engaged on same 14 miles in charge of ballasting, drainage, erection of station houses and water service. *Professional Specialty* —Location and construction of railways.

STEPHEN, ARTHUR, C.E. and Architect : *Practice*—General Engineering and Achitecture. *Location and Field*—Collingwood, Ont., and surrounding country. *Employment for year* 1889—Collingwood water works. Local Architecture. *Employment for year* 1890—Expects to be engaged on railway work in Texas.

NOTE.—As a record such as the foregoing cannot fail to be of interest to our members, and serves well to show that the Association is composed of men who are not only competent to undertake, but are carrying on important works throughout the Dominion, it is earnestly hoped that those whose names do not appear will, when again requested to do so, furnish the information required to compile a more complete and systematic record for our next Annual Report.

Secretary-Treasurer.

List of Members.

HONORARY MEMBERS.

BELL, ROBERT, B.A., Sc., C.E., M.D., LL.D., Assistant Director of the Geological and Natural History Survey of Canada.
Geological Survey, Ottawa, Ont.

BOULTON, J. G., Staff Commander, R.N., engaged in the Hydrographic Survey of the Georgian Bay of Lake Huron.
Ottawa, Ont.

DAWSON, GEORGE MERCER, D. Sc., Assoc. R.S.M., F.G.S., F.R.S.C., Assistant Director of the Geological and Natural History Survey of Canada.
Geological Survey, Ottawa, Ont.

DEVILLE, E., F.R.A.S., D.T.S., F.R.C.S., Surveyor General, Pres. of Board of Examiners for D.L. and D.T.S.
Technical Branch, Department of the Interior, Ottawa, Ont.

GALBRAITH, JOHN, M.A., D.T.S., Professor of Engineering, School of Practical Science, Toronto.
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HARRINGTON, BERNARD JAMES, B.A., Ph.D., F.G.S., F.R.S.C., Professor of Chemistry and Mineralogy, McGill College.
Walbrae Place, University Street, Montreal, Que.

KING, W. F., D.T.S., B A., Chief Astronomer to the Department of the Interior, Member of Board of Examiners for D.L. and D.T.S.
Technical Branch, Department of the Interior, Ottawa, Ont.

MACOUN, JOHN, M.A., F.L.S., F.R.S.C., Botanist and Naturalist to the Department of the Interior.
Geological Survey, Ottawa, Ont.

MAGRATH, BOULTON, Inspector of Schools, Member of Board of Examiners for D.L. and D.T.S.
Aylmer, Que.

SELWYN, ALFRED R. C., C.M.G., LL.D., F.R.S., Director of the Geological and Natural History Survey of Canada.
Geological Survey, Ottawa, Ont.

TACHE, E. E., Assistant Commissioner of Crown Lands, Quebec
Crown Lands Department, Que.

ACTIVE MEMBERS.

NOTE.—All active members are Dominion Topographical Surveyors or Dominion Land Surveyors.

ABREY, GEORGE BROCKITT, Provincial Land Surveyor for Ontario.
17 Yonge Street Arcade, Toronto, Ont.

BEATTY, WALTER, Provincial Land Surveyor for Ontario.
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BELLEAU, JOSEPH ALPHONSE, Provincial Land Surveyor for Quebec, Draughtsman, Department of Interior.
87 Water Street, Ottawa, Ont.

BIGGER, C. A., Provincial Land Surveyor for Ontario.
Ottawa, Ont.

BOURGAULT, CHARLES EUGENE, Provincial Land Surveyor for Quebec.
St. Jean Port Joli, Que.

BOWMAN, HERBERT J., Provincial Land Surveyor for Ontario, Grad. S.P. Sc. (Toronto), A.M. Can. Soc. C.E.
Berlin, Ont.

BRABAZON, S. L., Provincial Land Surveyor for Quebec.
Portage du Fort, Que

BRABAZON, A. J., Provincial Land Surveyor for Quebec.
Portage du Fort, Que.

BRADY, JAMES, Mining Engineer, Provincial Land Surveyor for Ontario.
80 Henry Street, Victoria, B.C.

BRAY, EDGAR, Provincial Land Surveyor for Ontario.
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BRAY, SAMUEL, Provincial Land Surveyor for Ontario, C.E., Vice-President of the Association, Indian Department.
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BREENE, THOMAS, Resident Engineer.
P. O Box 1041, Quebec, Que.

BROWNLEE, J. H., Provincial Land Surveyor for Ontario and Manitoba, Map Publisher, etc.
Brandon, Man.

CHALMERS, T. W., 1st Class, Royal Military College, Kingston, Inspector North-West Mounted Police.
Battleford, N.W.T.

COZENS, JOSEPH, Provincial Land Surveyor for Ontario, Town Engineer Sault Ste. Marie.
Sault Ste. Marie, Ontario.

CRAWFORD, WILLIAM,
Winnipeg, Man.

DE CHESNE, LUDGER MIVILLE, Provincial Land Surveyor for Quebec.
Village des Aulnets, St. Roch, L'Islet, Que.

DENNIS, J. S., D.T.S., Inspector of Surveys, Mem. Ex. Committee of the Association.
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DUFRESNE, J. I., D.T.S., Member of Board of Examiners for D. L. and D.T.S., Provincal Land Surveyor for Quebec.
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FREEMAN, N. A.,
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GARDEN, JAMES F., Provincial Land Surveyor for Ontario.
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Collingwood, Ont.

GORE, THOMAS S., Provincial Land Surveyor for Ontario.
Victoria, B.C.

Green, Thomas D., Provincial Land Surveyor for Ontario.
Department of Indian Affairs, Ottawa.

Harris, J. W., City Surveyor, Assessment Commissioner, Secretary P.L.S. Association and Board of Examiners for P.L.S. of Manitoba.
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Henderson, Walter, Provincial Land Surveyor for British Columbia.
Chilliwhack, B.C.

Irwin, Henry, B.A.L.C E., Trinity College, Dublin, Provincial Land Surveyor for Quebec, Assistant Engineer C. P. Railway.
103 Union Avenue, Montreal, Que.

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Portage La Prairie, Man.

Kirk, John Albert, Provincial Land Surveyor for Ontario.
New Westminster, B.C.

Klotz, Otto Julius, D.T.S.. C.E., (University of Michigan), Astronomer Department of the Interior, Member of Board of Examiners for D.L. and D.T.S. Mem. Ex. Committee of the Association.
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Laurie, Richard Camey, Provincial Land Surveyor for Manitoba.
Battleford, Saskatchewan District, N.W.T.

Maddock, Junius Arthur, Provincial Land Surveyor for Ontario.
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Magrath, Charles A., D.T.S., Land Commissioner, North-West Coal and Navigation Co.
Lethbridge, Alberta District, N.W.T.

Mountain, Geo. A., Provincial Land Surveyor for Ontario, Chief Engineer of Canada Atlantic Railway.
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Morency, D. C., Member of Board of Examiners for D.L. and D.T.S., Provincial Land Surveyor for Quebec, Inspector of Surveys, P.Q.
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McLatchie, John, Provincial Land Surveyor for Ontario and Quebec, Mem. of Ex. Committee of the Association.
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Nelson, J. C.,
Technical Branch, Department of Indian Affairs, Ottawa, Ont.
Regina, Assiniboia District, N.W T.

Niven, Alexander, Provincial Land Surveyor for Ontario.
Haliburton, Ont.

Ogilvie, William, Provincial Land Surveyor for Ontario, President of the Association.
Gloucester, Ont.

Pearce, William, Provincial Land Surveyor for Ontario, Superintendent of Mines. Member of Dominion Lands Board, Member of Board of Examiners for D.L. and D.T.S.
Calgary, Alberta District, N.W.T.

Purvis, Frank, Provincial Land Surveyor for Ontario, Municipal Engineer.
Eganville, Ont.

Poudrier, A. L., Provincial Land Surveyor for Quebec.
Donald, B.C.

Patten, T. J., Provincial Land Surveyor for Ontario.
Little Current, Ont.

Rauscher, R,, Provincial Land Surveyor for Quebec.
Technical Branch, Department of the Interior, Ottawa, Ont.

Reid, J. Lestock, Provincial Land Surveyor for Ontario.
Port Hope, Ont.

Robertson, Henry H., Provincial Land Surveyor for Quebec.
St. Thomas de Montmagny, Que.

Sirois, Joseph Eustache, Provincial Land Surveyor for Quebec, Civil Engineer and Hydrographic Surveyor.
P. O. Box 26, Ste. Anne de la Pocatiere, Kamouraska Co., Que.

Selby, Henry W., Provincial Land Surveyor for Ontario.
Stayner, Ont.

Sewell, H. DeQ., Provincial Land Surveyor for Ontario, Mining Engineer, Assoc. M. Inst. C.E.
Port Arthur, Ont.

Starkey, S. M., Provincial Land Surveyor for Quebec.
Starkey, N.B.

Stewart, Louis Beaufort, D.T.S., Provincial Land Surveyor for Ontario.
Banff, Alberta District, N.W.T.

Symmes, Charles Thomas, Second Engineer of the Inspeccion General of Ferrocarriles en Construccion.
Ferrocarriles del Estado, Linea de Talca a Constitucion, Talca, Chile.

St. Cyr, Arthur.
Almonte House, Ottawa, Ont.

Talbot, A. C., Provincial Land Surveyor for Quebec.
Montmagny, Que.

Talbot, Pierre Cleophas, Provincial Land Surveyor for Quebec.
Montmagny, Que.

Thompson, W. T., D.T.S.
Qu'Appelle Station, Assinaboia District, N.W.T

Vicars, John, Provincial Surveyor for Ontario.
Cannington, Ont.

Webb, A. C., Member of Board of Examiners for D.L. and D.T.S., Provincial Land Surveyor for Ontario.
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White, George W. R. Montagu, F.R.S.G.S., Civil Engineer.
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Wheeler, Arthur O., Provincial Land Surveyor for Ontario and Manitoba, Sec.-Treasurer of the Association,
Timber, Mines and Grazing Lands Office,
Departmentof the Interior, Ottawa, Ont.

ASSOCIATE MEMBERS.

Coste, Eugene M. A, M.E. Graduate of the Ecole Nationale Superieure des Mines de Paris, France, Manager of the Provincial Natural Gas and Fuel Co. of Ontario.
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Golden, British Columbia.

Clayton, Frank, Surveyor and Draughtsman.
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Hebert, Edmond Antoine, (Laval University and Archambault School), C.E., Resident Engineer of the Great Eastern Railway (Nicolet Section).
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McEvoy, James, B.A.Sc., Geological Surveyor, Geological and Natural History Survey of Canada.
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McNutt, Charles, B.A.Sc. (McGill), Mining and Civil Engineer.
Aspin, Colorado, U.S.A.

Odell, C.M., C.E., Assoc. Mem. Can. Soc. Civil Engineers.
Truro, N.S.

Smith, Jacob, Civil Engineer, Draughtsman, etc.
Banff, Alberta District, N.W.T.

Symes, P. B., Associate of Applied Science, King's College, London, Eng. Department of the Interior.
326 Lyon Street, Ottawa, Ont.

Stephen, Arthur, Architect and Engineer.
Collingwood, Ont.

Topley, H. N, Photographer to the Department of the Interior of Canada.
Ottawa, Ont.

Note: Should there be an error in the name, standing or address of any gentleman in the foregoing list, the Secretary Treasurer will be not only happy to correct the same in the next issue, but will be very much obliged for any information that will enable him to do so.

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